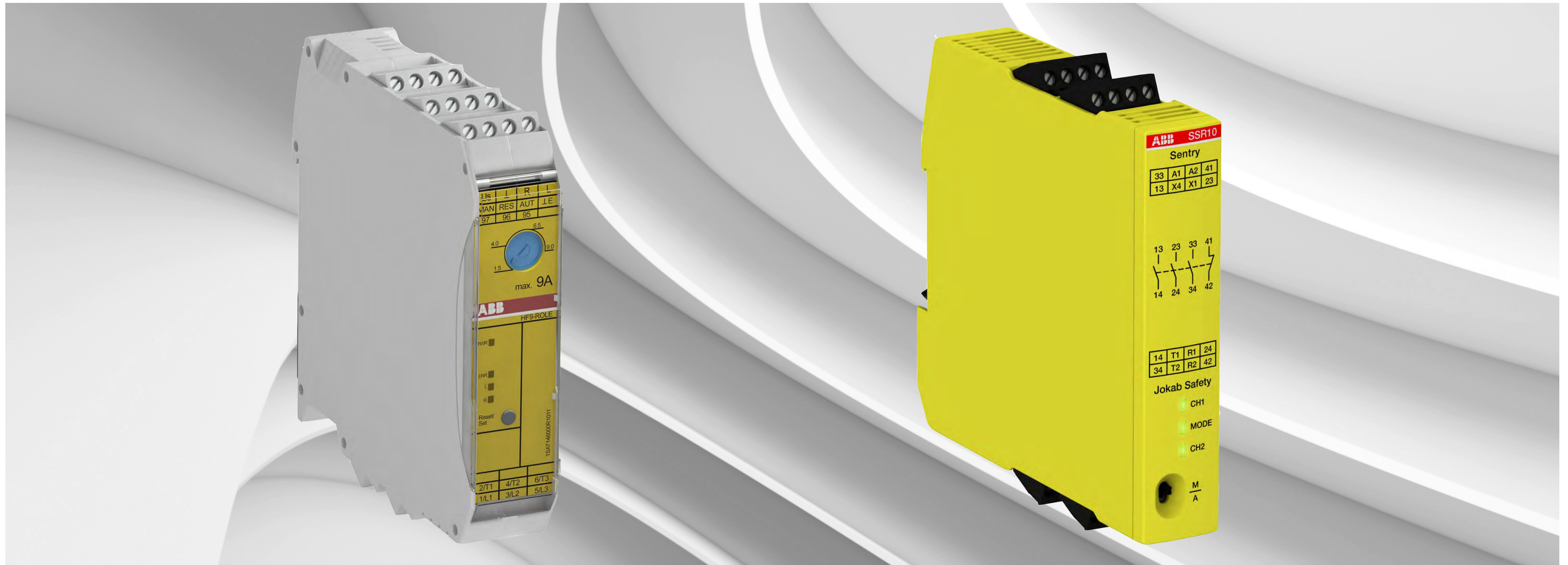


# Wiring diagrams

HF-Starter and Sentry Safety relay SSR10



#	Type	Lead connection	Connection between HF-starter and SSR10	Connection diagram (HF & SSR10)	Functional diagram	Application	Achievable SIL/Cat-PL - level	Channels	Maximal lifetime possible	Comment	Requirement	Questions/Notes
1	HFxx-DOLE-24VDC	+24 V DC to SSR10 (14/13, NO) to control terminal “ON” and from “ground E” to 0 V DC	ON			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, the HF-Starter is turned on/off through the control terminal “ON”. So, the semiconductors are activated by the logic mirco-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.  <b>Advantages</b> <ul style="list-style-type: none"> <li>Max. lifetime of HF-Starter.</li> </ul> <b>Disadvantages</b> <ul style="list-style-type: none"> <li>“On” terminal is occupied by SSR10</li> <li>HF and SSR10 must be mounted in the same control cabinet</li> </ul>	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 13849-2:2012 table D.4.	
2	HFxx-DOLE-24VDC	+24 V DC to control terminal “ON” to “ground E”, to SSR10 (13/14, NO) to 0 V DC	Ground E			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, the HF-Starter is turned 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.  <b>Advantages</b> <ul style="list-style-type: none"> <li>Max. lifetime of HF-Starter can be reached</li> <li>“ON” terminal is not occupied from SSR10 and can be connected to supply voltage or PLC</li> </ul> <b>Disadvantages</b> <ul style="list-style-type: none"> <li>None. This wiring type is recommended. Please make provision that HF and SSR10 are mounted in the same control cabinet.</li> </ul>	This wiring type is recommended.  If a 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 effect 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 13849-2:2012 table D.4.	
3	HFxx-DOLE-24VDC	+24 V DC to SSR10 (14/13, NO) to control supply terminal “U <sub>s</sub> ” to “ground” to 0 V DC	U <sub>s</sub>			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 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 <sub>s</sub> ” 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.  <b>Advantages</b> <ul style="list-style-type: none"> <li>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.</li> </ul> <b>Disadvantages</b> <ul style="list-style-type: none"> <li>Life time of HF is reduced to 10.000 switching cycles instead of 30.000.000</li> <li>HF and SSR10 must be mounted in same control cabinet</li> </ul>	This wiring type is not recommended as it could reduce lifetime from 30.000.000 cycles to 10.000 cycles.	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 13849-2:2012 table D.4.	When is it recommended to connect U <sub>s</sub> or ground to SSR10?  It is recommended if the customer wants to safe contacts by the safety relay, especially for the HFxx-ROLE versions.

#	Type	Lead connection	Connection between HF-starter and SSR10	Connection diagram (HF & SSR10)	Functional diagram	Application	Achievable SIL/Cat-PL - level	Channels	Maximal lifetime possible	Comment	Requirement	Questions/Notes
4	HFxx-DOLE-24VDC	+24 V DC to control supply terminal “U <sub>s</sub> ” to “ground” to SSR10 (13/14, NO) to 0 V DC	Ground			Emergency stop application	IEC 61508-1: SIL 3;  ISO 13849-1: Cat3, PL e;  EN 954-1: Cat3	Single channel with fault exclusion	<p>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<sub>s</sub>” and “ground” connection 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.</p> <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>Only one terminal of SSR10 is needed per</li> <li>HF-Starter to realize emergency stop; the customer is “saving” contacts (NO/NC) on the SSR10; this brings an advantage in group mounting.</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>Life time of HF is reduced to 10.000 switching cycles instead of 30.000.000</li> <li>HF and SSR10 must be mounted in same control cabinet</li> </ul>	This wiring type is not recommended as it could reduce lifetime from 30.000.000 cycles to 10.000 cycles.	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 13849-2:2012 table D.4.	<p>When is it recommended to connect U<sub>s</sub> /ground to SSR10?</p> <p>It is recommended if the customer wants to safe contacts by the safety relay.</p>
5	HFxx-DOLE-24VDC	+24 V DC to SSR10 (24/23, NO) to control terminal “ON” to “ground E” and back to SSR10 (13/14, NO) to 0 V DC	ON, ground E			Safety door / two-hand- / emergency stop-application	IEC 61508-1: SIL 3;  ISO 13849-1: Cat3, PL e;  EN 954-1: Cat3	Dual channel	<p>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 mirco-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.</p> <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>Max. lifetime</li> <li>HF and SSR10 must not be mounted in the same control cabinet</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>Two contact on SSR10 are occupied.</li> </ul>	<p>This wiring type is recommended.</p> <p>If shutdown is performed, e.g. from a “safe controller” with semiconductor outputs, the residual voltage must be &lt; 5 V DC. Interruptions &lt; 3 ms are filtered.</p> <p>HF-Starter and SSR10 must not be installed in the same control cabinet as two leads are connected.</p>	Two lead connection from HF to SSR10	
6	HFxx-DOLE-24VDC	+24 V DC to SSR10 (14/13, NO) to control supply voltage “U <sub>s</sub> ” to “ground” and back to SSR10 (23/24, NO) to 0 V DC	U <sub>s</sub> , ground			Safety door / two-hand- / emergency stop-application	IEC 61508-1: SIL 3;  ISO 13849-1: Cat3, PL e;  EN 954-1: Cat3	Dual channel	<p>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<sub>s</sub>” 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.</p> <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>HF and SSR10 must not be mounted in same control cabinet</li> <li>“ON” terminal could be connected to PLC</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>Life time of HF is reduced to 10.000 switching cycles instead of 30.000.000.</li> </ul>	<p>This wiring type is not recommended as it could reduce lifetime from 30.000.000 cycles to 10.000 cycles.</p> <p>HF-Starter and SSR10 must not be installed in the same control cabinet as two leads are connected.</p>	Two lead connection from HF to SSR10	

#	Type	Lead connection	Connection between HF-starter and SSR10	Connection diagram (HF & SSR10)	Functional diagram	Application	Achievable SIL/Cat-PL - level	Channels	Maximal lifetime possible	Comment	Requirement	Questions/Notes
7	HFxx-ROLE-24VDC	+24 V DC to SSR10 (24/23, NO) to control terminal “R” to ground E to 0 V DC; +24 V DC to SSR10 (14/13, NO) to control terminal “L” to ground E to 0 V DC	R, L			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	<p>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 mirco-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors takes over the current and the relays de-energize without load.</p> <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>Max. lifetime</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>Two contact on SSR10 are occupied</li> <li>HF and SSR10 must be mounted in the same control cabinet</li> </ul>	<p>This wiring type is recommended.</p> <p>If shutdown is performed, e.g. from a “safe controller” with semiconductor outputs, the residual voltage must be &lt; 5 V DC. Interruptions &lt; 3 ms are filtered and do not effect the device.</p>	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 13849-2:2012 table D.4.	<p>Is there any delay if the HF-Starter is turned off through the control terminals (R,L) instead of control supply terminal (U<sub>s</sub>)? No, there is not delay. The shut down time is the same.</p> <p>Is this a single lead connection because control terminal “R” and “L” have the same root “ground”? No, it is single channel connection, because the a failure on one terminal can make the device let start the motor. As HF and SSR10 must be mounted in the same control cabinet, the probablity of failure is also reduced.</p>
8	HFxx-ROLE-24VDC	+24 V DC to control terminal “R” and “L” common root “ground E” is connected to SSR10 (13/14, NO) to 0 V DC	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	<p>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 mirco-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.</p> <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>Max. lifetime</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>Two contact on SSR10 are occupied</li> <li>HF and SSR10 must be mounted in the same control cabinet</li> </ul>	<p>This wiring type is recommended.</p> <p>If shutdown is performed, e.g. from a “safe controller” with semiconductor outputs, the residual voltage must be &lt; 5 V DC. Interruptions &lt; 3 ms are filtered.</p> <p>Compared to #7 this wiring option only requires 1NO contact of the SSR10 device. For emergency stop applications which requires group mounting HF-Starter, an economical solution is proposed here.</p>	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 13849-2:2012 table D.4.	
9	HFxx-ROLE-24VDC	+24 V DC to SSR10 (14/13, NO) to control supply terminal “U <sub>s</sub> ” to ground	U <sub>s</sub>			Emergency stop application	IEC 61508-1: SIL 3; ISO 13849-1: Cat3, PL e; EN 954-1: Cat3	Single channel with fault exclusion	<p>The mechanical switching lifetime is limited to only 10.000 switching cycles. The “control supply voltage U<sub>s</sub>” 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.</p> <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>Only one terminal of SSR10 is needed per</li> <li>HF-Starter to realize emergency stop; the customer is “saving” contacts (NO/NC) on the SSR10; this brings an advantage in group mounting.</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>Life time of HF is reduced to 10.000 switching cycles instead of 30.000.000</li> <li>HF and SSR10 must be mounted in same control cabinet</li> </ul>	<p>This wiring type is not recommended as it reduces lifetime from 30.000.000 cycles to 10.000 cycles.</p>	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 13849-2:2012 table D.4.	<p>Why should I connect the SSR10 to “U<sub>s</sub>” instead of “R, L, or ground E”? What is the benefit of doing this? By connecting only U<sub>s</sub>, instead of R and L the customer can use less NO/ NC contacts of the Sentry Safety relay. .</p>

#	Type	Lead connection	Connection between HF-starter and SSR10	Connection diagram (HF & SSR10)	Functional diagram	Application	Achievable SIL/Cat-PL - level	Channels	Maximal lifetime possible	Comment	Requirement	Questions/Notes
10	HFxx-ROLE-24VDC	+24 V DC to control supply terminal “U <sub>s</sub> ” to ground to SSR10 (13/14, NO) to ground	Ground			Emergency stop application	IEC 61508-1: SIL 3;  ISO 13849-1: Cat3, PL e;  EN 954-1: Cat3	Single channel with fault exclusion	<p>The mechanical switching lifetime is limited to only 10.000 switching cycles. The “control supply voltage U<sub>s</sub> 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.</p> <p><b>Advantages</b></p> <ul style="list-style-type: none"><li>• Only one terminal of SSR10 is needed per</li><li>• HF-Starter to realize emergency stop; the customer is “saving” contacts (NO/NC) on the SSR10; this brings an advantage in group mounting.</li></ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"><li>• Life time of HF is reduced to 10.000 switching cycles instead of 30.000.000</li><li>• HF and SSR10 must be mounted in same control cabinet</li></ul>	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-DOLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to ISO 13849-2:2012 table D.4	Why should I connect the SSR10 to “U <sub>s</sub> ” instead of “R, L, or ground E”? What is the benefit of doing this? By connecting only U <sub>s</sub> , instead of R and L the customer can use less NO/NC contacts of the Sentry Safety relay.
11	HFxx-ROLE-24VDC	+24 V DC to SSR10 (24/23, 34/33, NO) to control terminal “R” and “L” and from “ground E” back to SSR10 (13/14, NO) to 0 V DC	R, L, ground E			Safety door / two-hand- / emergency stop application	IEC 61508-1: SIL 3;  ISO 13849-1: Cat3, PL e;  EN 954-1: Cat3	Dual channel	<p>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 mirco-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.</p> <p><b>Advantages</b></p> <ul style="list-style-type: none"><li>• Max. lifetime</li><li>• HF and SSR10 must not be mounted in the same control cabinet</li></ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"><li>• Three contacts on SSR10 are occupied.</li></ul>	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 mirco-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.	With two channel connection the HF-Starter and SSR10 must not be mounted in the same control cabinet.	
12	HFxx-ROLE-24VDC	+24 V DC to SSR10 (14/13, NO) to control supply terminal “U <sub>s</sub> ” and from control terminal “ground” back to SSR10 (23/24, NO) to 0 V DC	U <sub>s</sub> , ground			Emergency stop (two channels)	IEC 61508-1: SIL 3;  ISO 13849-1: Cat3, PL e;  EN 954-1: Cat3	Dual channel	<p>The mechanical switching lifetime is limited to only 10.000 switching cycles. The “control supply voltage U<sub>s</sub> 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.</p> <p><b>Advantages</b></p> <ul style="list-style-type: none"><li>• HF and SSR10 must not be mounted in the same control cabinet.</li></ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"><li>• Life time of HF is reduced to 10.000 switching cycles instead of 30.000.000</li></ul>	This wiring type is not recommended as it reduces lifetime from 30.000.000 cycles to 10.000 cycles.	With two channel connection the HF-Starter and SSR10 must not be mounted in the same control cabinet.	