Safety Relay HR1S-AC

Key features:

- 1NC or 2NC safety input type, such as E-Stops or Interlock Switches
- EN ISO 13849-1 PLe, Safety Cat 3 compliant, and EN 62061 SIL 3
- Fault diagnosis function with dual safety circuits.
- Internal relay operations can be monitored with LED Indicator.
- Finger-safe protection
- 22.5mm wide, 35mm DIN rail mounting
- UL listed, CSA certified, TÜV NORD approved

Part Numbers

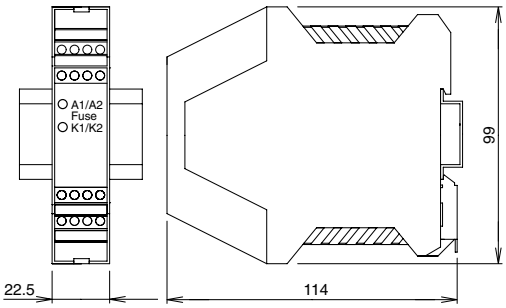
Part Number	Terminal Style
HR1S-AC5121	Integrated Terminal Block
HR1S-AC5121P	Removable Terminal Block

Specifications

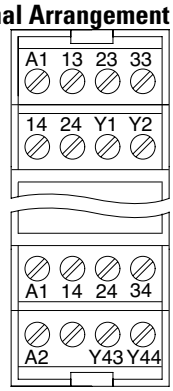
Operating Temperature			–10 to 55°C (no freezing)
Degree of Protection			Terminal: IP20, Housing: IP40
Rated Power Voltage			24V AC (–20 to +10%) 50/60 Hz 24V DC (±20%)
Power Consumption			AC: 2.2 VA (24V AC) maximum DC: 1.2W (24V DC) maximum
Overcurrent Protection			Electronic
Control Circuit Voltage			24V
Performance Level (PL)			e (EN ISO 13849-1)
Safety Category			3 (EN 954-1)
Safety Integrity Level (SIL)			3 (EN 62061)
Response Time			100ms maximum
Input Synchronization Time			Unlimited
Overvoltage Category			III
Pollution Degree			2
Rated Insulation Voltage			300V
Safety Outputs	Instantaneous (Stop Cat 0)		3NO
	Auxiliary Contact		1NO (transistor, PNP)
Output Contact Ratings	Safety Circuit	AC-15	C300: Ue= 240VAC, Ie=0.75A
		DC-13	Ue=24VDC, Ie=2A
	Transistor Circuit		24V/20mA
	Minimum Applicable Load		17V/10mA (initial value)
Operation Frequency			1200 operations/h maximum
Rated Current			Safety circuit output total: 10.5A maximum
Wire Size			HR1S-AC5121: 1 × 2.5mm², 2 × 0.75mm² maximum HR1S-AC5121P: 1 × 2.5mm², 2 × 1.5mm² maximum
Weight			160g

Use a 4A fuse (Type gL) for power fuse protection.
Use a 4A (Type gL) or a 6A fast blow fuse for output fuse protection

Dimensions (mm)

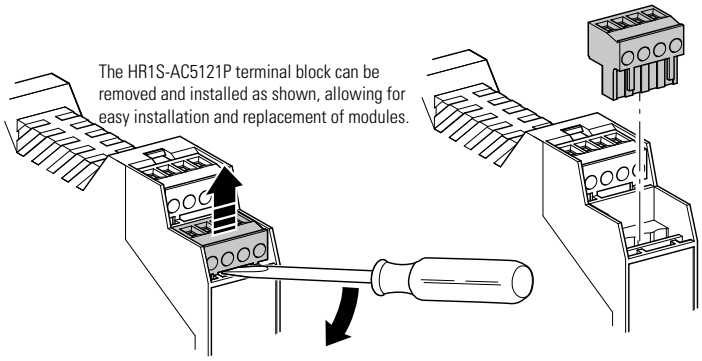


Terminal Arrangement



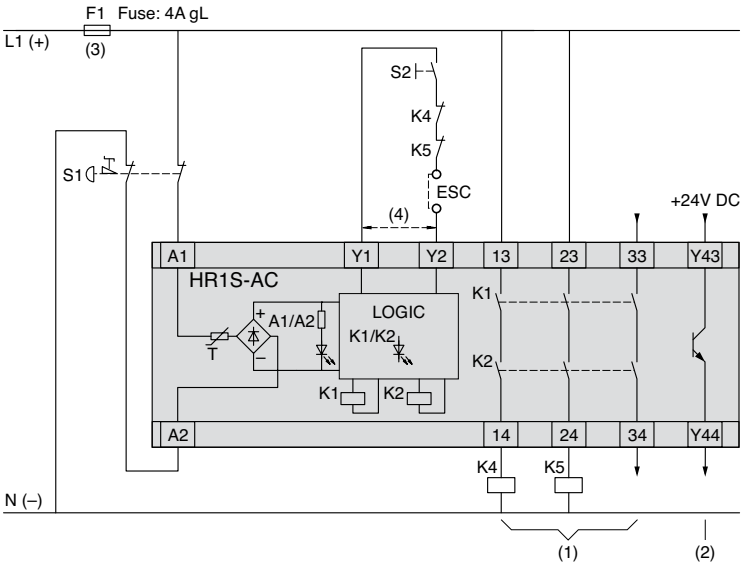
LED Indicator

- A1/A2 Fuse:
  Turns on when power circuit is normal.
  Turns off when power is interrupted or the electronic fuse blows.
- K1: Turns on when K1 relay operates.
- K2: Turns on when K2 relay operates.

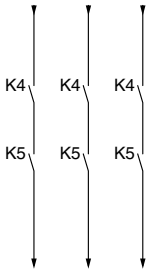


HR1S-AC Wiring Diagram

Safety Category 3 Example Circuit (using an emergency stop switch with 2NC contacts)



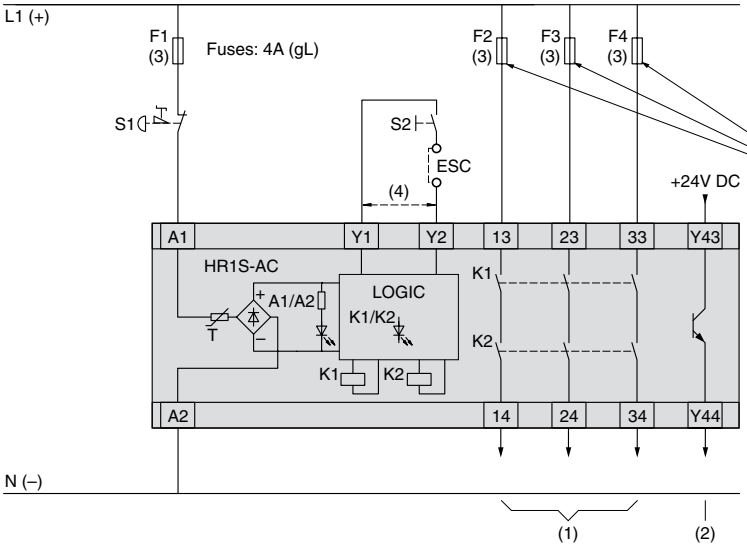
ESC: External Start Condition
S1: Emergency Stop Switch
S2: Start Switch
F1: Protection fuse for the power of safety relay module
K4, 5: Safety contactor



The Safety Category is achieved by the entire control system. Take any connected safety equipment and wiring into consideration.

(1) Three safety outputs
(2) One transistor output
(3) See the specifications for maximum fuse size
(4) Jumper for terminal Y1-Y2 (for automatic start)

Safety Category 3 Example Circuit (using an emergency stop switch with 2NC contacts)

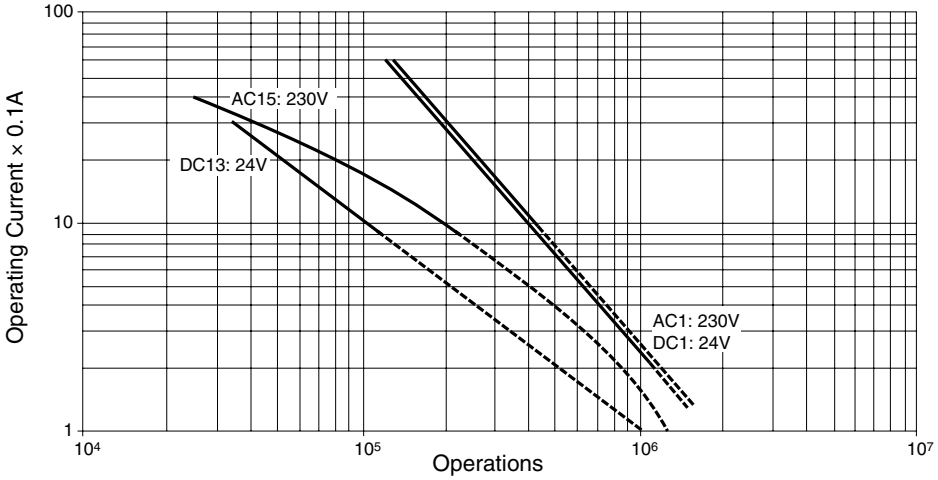


ESC: Exernal Start Condition
S1: Emergency Stop Switch
S2: Start Switch
F1: Protection fuse for the power of safety relay module
F2 to F4: Protection fuse for the output of safety relay module

Fuses: 4A (gL) or 6A fast blow type

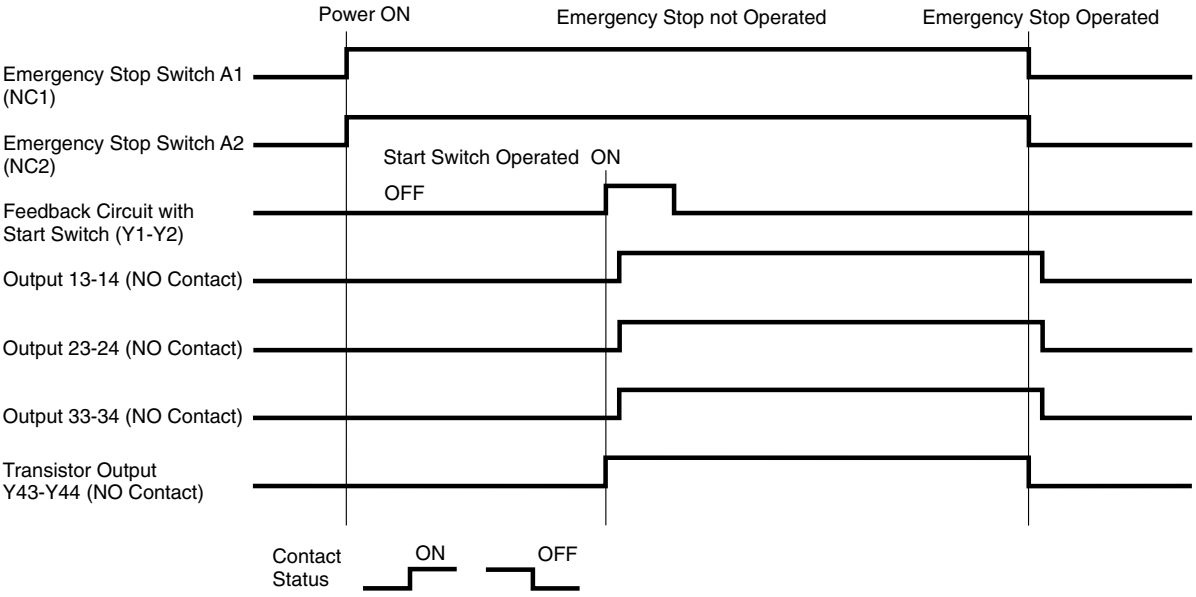
(1) Three safety outputs
(2) One transistor output
(3) See the specifications for maximum fuse size

Output Contact Electrical Life

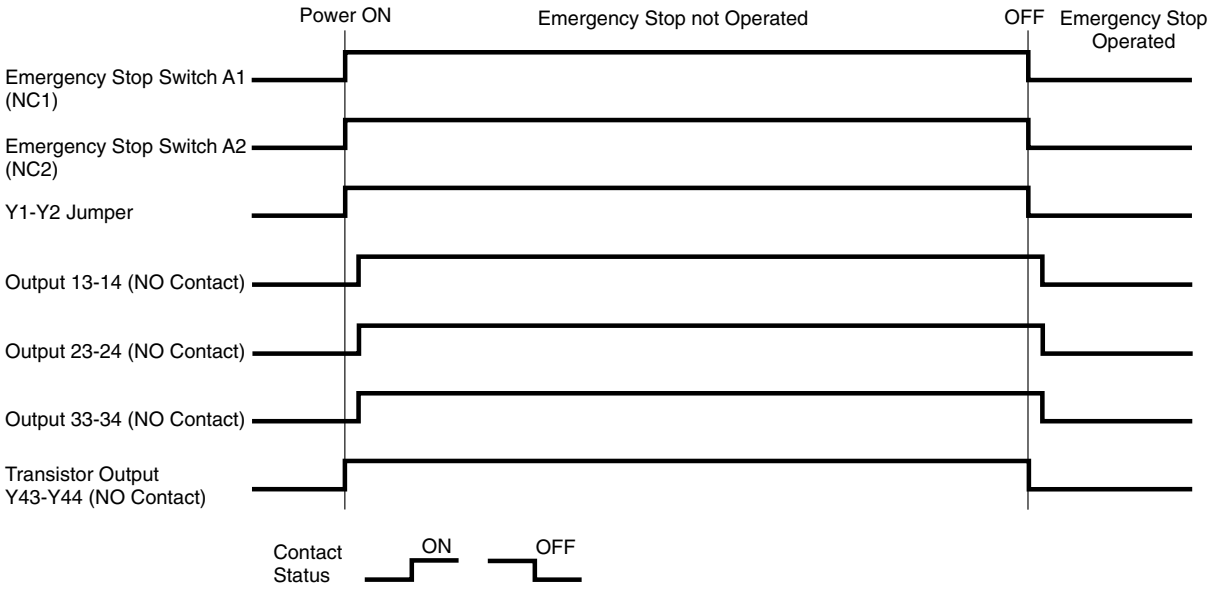


HR1S-AC Safety Relay Module Operation Chart

When Using a Start Switch



When Not Using a Start Switch



Safety Relay HR1S-AF

Key features:

- 2NC safety input type, such as E-Stops or Interlock Switches
- EN ISO 13849-1 PLe, Safety Cat 4 compliant, and EN 62061 SIL 3
- Welding detection of start switch
- Fault diagnosis function with dual safety circuits
- Internal relay operations can be monitored with LED Indicator.
- Finger-safe protection
- 22.5mm wide, 35mm DIN rail mounting
- UL listed, CSA certified, TÜV NORD approved

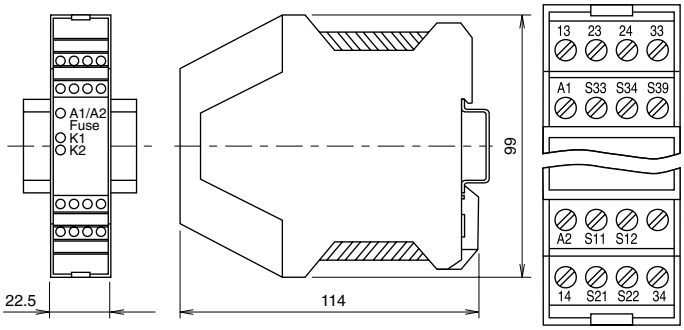
Part Numbers

Part Number	Terminal Style
HR1S-AF5130B	Integrated Terminal Block
HR1S-AF5130PB	Removable Terminal Block

Specifications

Operating Temperature			–25 to +55°C (no freezing)
Degree of Protection			Terminal: IP20, Housing: IP40
Rated Power Voltage			24V AC (–15 to +10%) 50/60 Hz 24V DC (–15 to +10%)
Power Consumption			5 VA maximum (24V AC) 2.5W maximum (24V DC)
Overcurrent Protection			Electronic (Note)
Control Circuit Voltage			24V
Performance Level (PL)			e (EN ISO 13849-1)
Safety Category			4 (EN ISO 13849-1)
Safety Integrity Level (SIL)			3 (EN 62061)
Response Time			When S11-S12, S21-S22 are interrupted: 20 ms maximum When power is interrupted: 60 ms maximum
Input Synchronization Time			Unlimited
Overvoltage Category			III
Pollution Degree			2
Rated Insulation Voltage			300V
Safety Outputs	Instantaneous (Stop Cat 0)		3NO
Output Contact Ratings	Safety Circuit	AC-15	C300: Ue= 240VAC, Ie=0.75A
		DC-13	Ue=24VDC, Ie=2A
	Minimum Applicable Load		17V/10mA (initial value)
Operation Frequency			1200 operations/h maximum
Rated Current			Safety circuit output total: 18A maximum Each safety circuit output: 6A maximum
Wire Size			HR1S-AF5130B: 1 × 2.5 mm², 2 × 0.75 mm² maximum HR1S-AF5130PB: 1 × 2.5 mm², 2 × 1.5 mm² maximum
Weight			250g

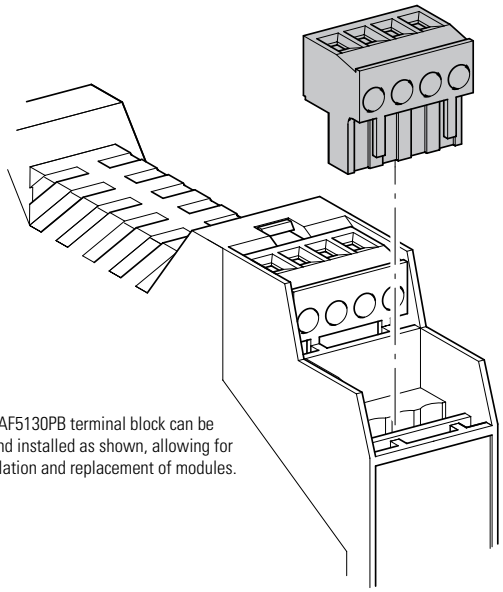
Dimensions (mm)



Terminal Arrangement

LED Indicator

- A1/A2 Fuse:
  Turns on when power circuit is normal.
  Turns off when power is interrupted or the electronic fuse blows.
- K1: Turns on when K1 relay operates.
- K2: Turns on when K2 relay operates.



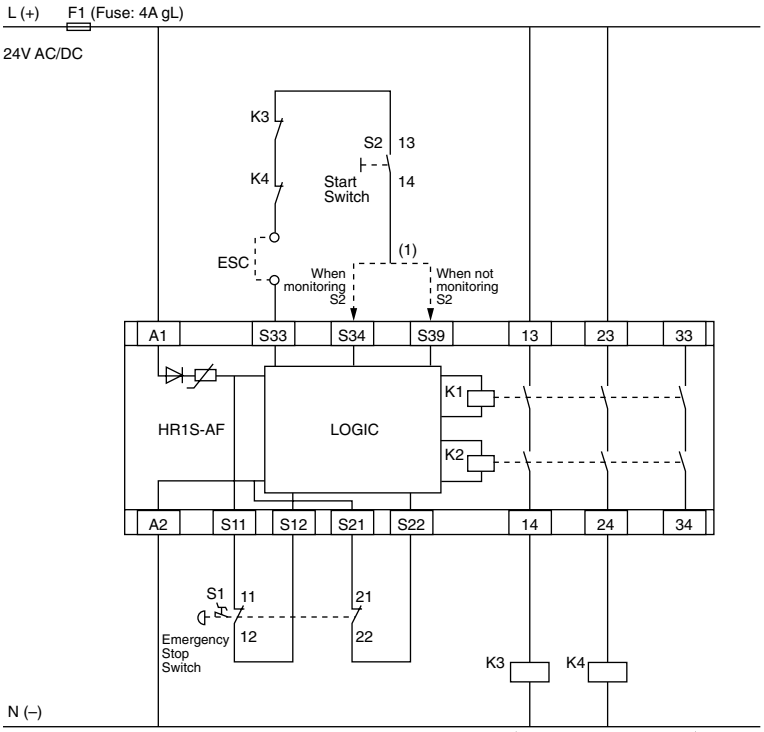
The HR1S-AF5130PB terminal block can be removed and installed as shown, allowing for easy installation and replacement of modules.

Note: Short-circuit of S11 and S21 activates the overcurrent protection circuit, interrupting the power supply. The safety output turns off. Normal status is restored when the short-circuit is removed. Use a 4A fuse (Type gL) for power line protection. Use a 4A fuse (Type gL) or a 6A fast blow fuse for output line protection.

HR1S-AF Wiring Diagram

Safety Category 4 Example Circuit (using an emergency stop switch)

The Safety Category is achieved by the entire control system. Take any connected safety equipment and wiring into consideration.

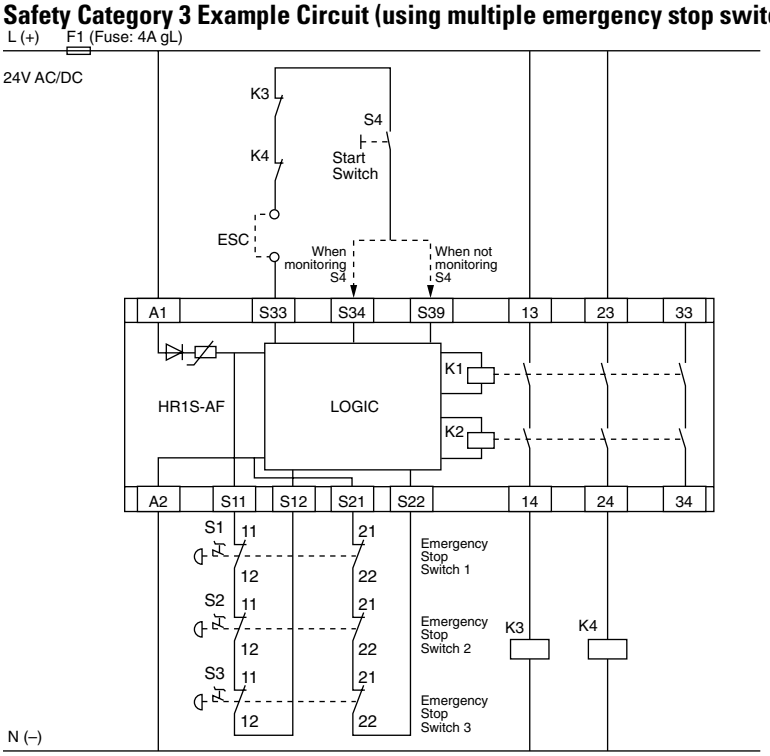


(1) = Start Switch Monitor

ESC: External Start Condition
F1: Protection fuse for the power of safety relay module
K3, 4: Safety contactor

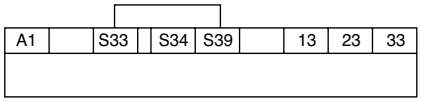
Safety Output 3 Circuits

Safety Category 3 Example Circuit (using multiple emergency stop switches)



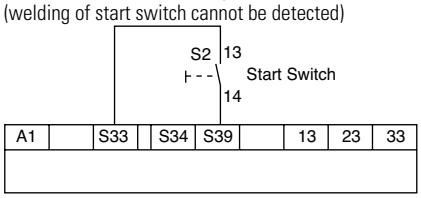
ESC: External Start Condition
F1: Protection fuse for the power of safety relay module
K3, 4: Safety contactor

When not using a start switch (automatic start)



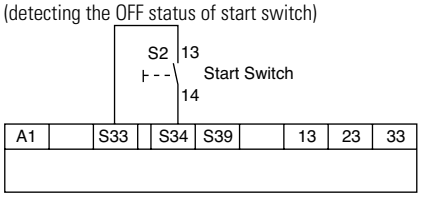
When not monitoring the start switch

(welding of start switch cannot be detected)



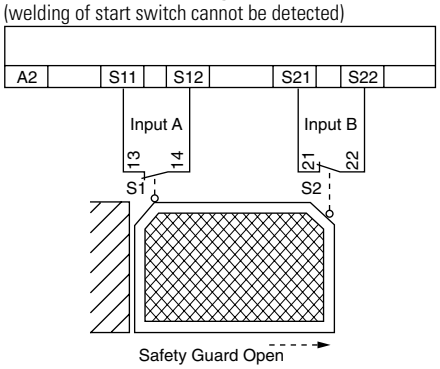
When monitoring the start switch

(detecting the OFF status of start switch)



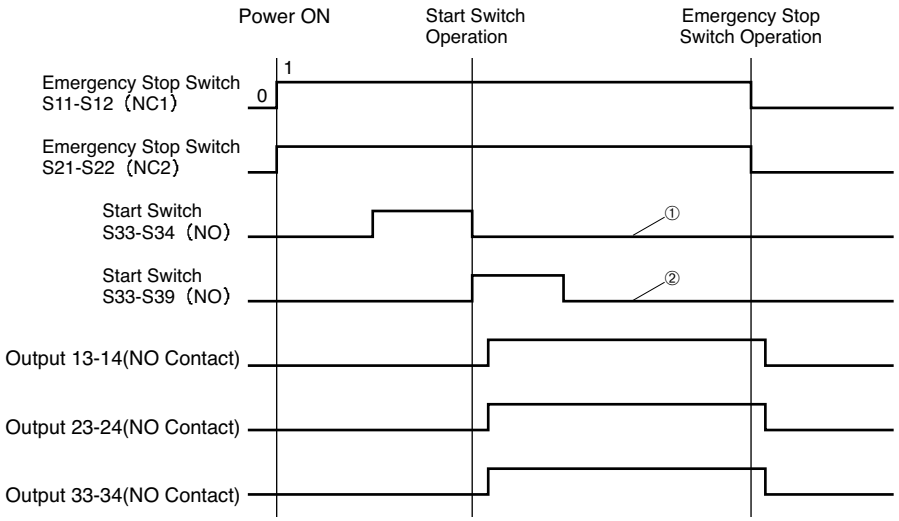
When not monitoring the start switch

(welding of start switch cannot be detected)



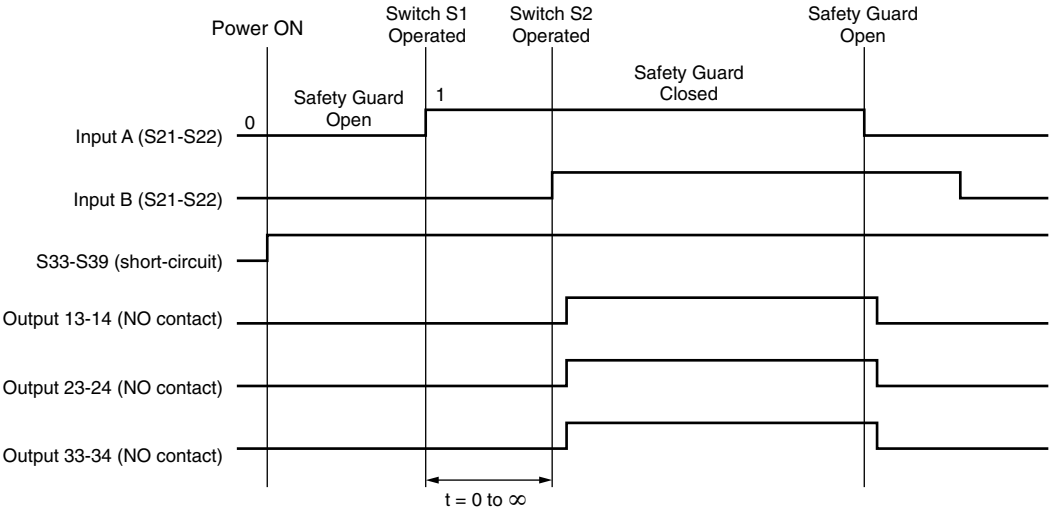
HR1S-AF Operation Chart

When Using the Emergency Stop Switch

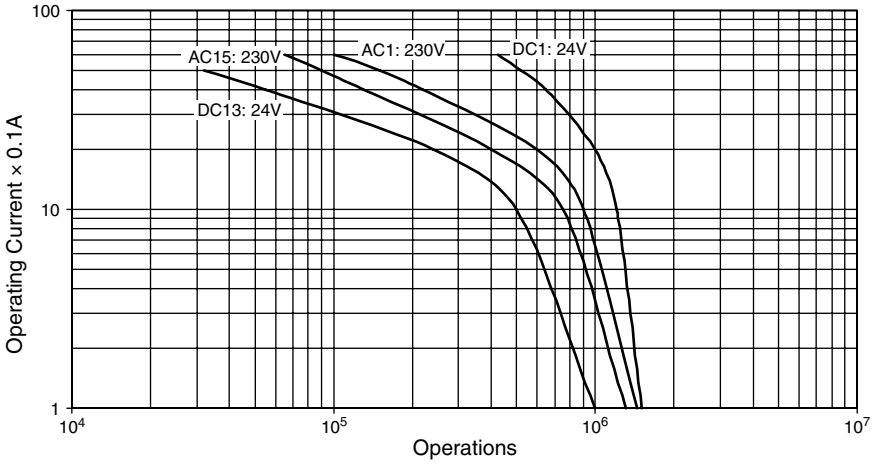


① When monitoring the start switch (detecting the OFF status of start switch)
② When not monitoring the start switch (contact welding of start switch cannot be detected)

When not Using the Safety Guard (Automatic Start)



Output Contact Electrical Life



Safety Relay HR1S-DM

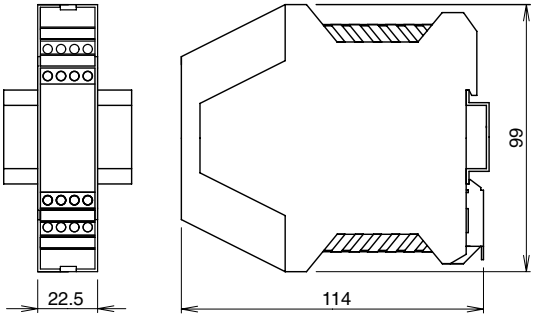
Key features:

- 1NO-1NC safety input type, such as magnetic coded safety switches
- Fault diagnosis function with dual safety circuits.
- Internal relay operations can be monitored with LED Indicator.
- Finger-safe protection
- 22.5 or 45mm wide, 35mm DIN rail mounting
- EN ISO 13849-1 PLe, Safety Cat 4 compliant, and EN 62061 SIL 3
- UL listed, CSA certified, TÜV NORD approved

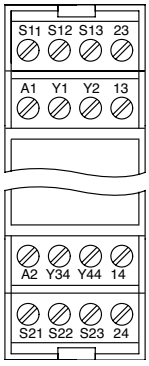
Part Numbers

Part Number	Terminal Style	Input
HR1S-DMB1132	Integrated Terminal Block	2
HR1S-DMB1132P	Removable Terminal Block	
HR1S-DME1132	Integrated Terminal Block	6
HR1S-DME1132P	Removable Terminal Block	

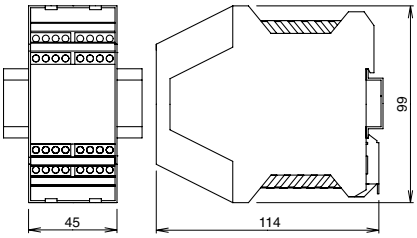
Dimensions (mm) HR1S-DMB



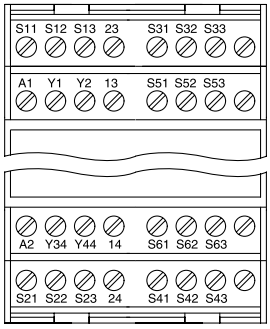
Terminal Arrangement HR1S-DMB



Dimensions (mm) HR1S-DME



Terminal Arrangement HR1S-DME



Specifications

Operating Temperature			–10 to 55°C (no freezing)
Degree of Protection			Terminal: IP20, Housing: IP40
Rated Power Voltage			24V DC (–20 to +20%)
Power Consumption			HR1S-DMB: 2.5W maximum (24V DC) HR1S-DME: 3.5W maximum (24V DC)
Overcurrent Protection			Electronic
Control Circuit Voltage			24V DC
Performance Level (PL)			e (EN ISO 13849-1)
Safety Category			4 (EN ISO 13849-1)
Safety Integrity Level (SIL)			3 (EN 62061)
Response Time			20 ms maximum
Input Synchronization Time			500ms max
Overvoltage Category			III
Pollution Degree			2
Rated Insulation Voltage			300V
Maximum Input Resistance			100Ω (per input point)
No. of Outputs	Safety Circuit		2NO
	Auxilliary Contact		2NO (transistor PNP)
Output Contact Ratings	Safety Circuit	AC-15	C300: Ue= 240VAC, Ie=0.75A
		DC-13	Ue= 24V DC, Ie= 1.5A
	Transistor Circuit		24V/20 mA
	Minimum Applicable Load		17V/10 mA (initial value)
Operation Frequency			1200 operations/hour maximum
Rated Current			Output total 12A maximum
Wire Size			0.14 to 2.5 mm^2
Weight			HR1S-DMB: 180g HR1S-DME: 250g

Use a 4A fuse (Type gL) for power fuse protection.
Use a 4A (Type gL) or a 6A fast blow fuse for output fuse protection.

LED Indicator

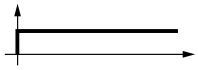
HR1S-DMB

- Power A1/A2:
  Turns on when power circuit is normal.
  Turns off when power is interrupted or the electronic fuse blows.
- Fault:
  Turns on when the HR1S fails (see failure causes on page 694).
- K1/K2:
  Turns on when K1/K2 relays operate.

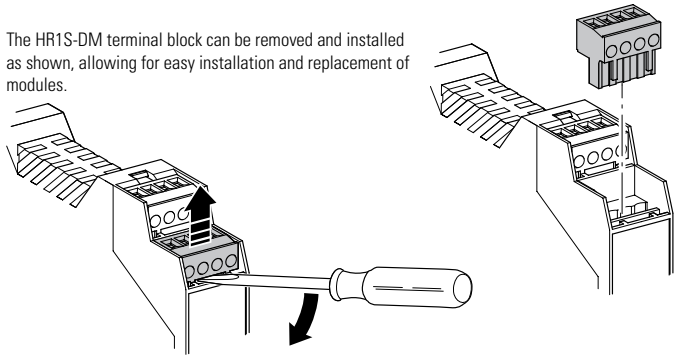
HR1S-DME

- Power A1/A2:
  Turns on when power circuit is normal.
  Turns off when power is interrupted or the electronic fuse blows.
- Fault:
  Turns on when the HR1S fails (see failure causes on page 694)
- K1/K2:
  Turns on when K1/K2 relays operate.
- S13: NO contact of non-contact interlock switch 1
- S12: NC contact of non-contact interlock switch 1
- S23: NO contact of non-contact interlock switch 2
- S22: NC contact of non-contact interlock switch 2
- S33: NO contact of non-contact interlock switch 3
- S32: NC contact of non-contact interlock switch 3
- S43: NO contact of non-contact interlock switch 4
- S42: NC contact of non-contact interlock switch 4
- S53: NO contact of non-contact interlock switch 5
- S52: NC contact of non-contact interlock switch 5
- S63: NO contact of non-contact interlock switch 6
- S62: NC contact of non-contact interlock switch 6

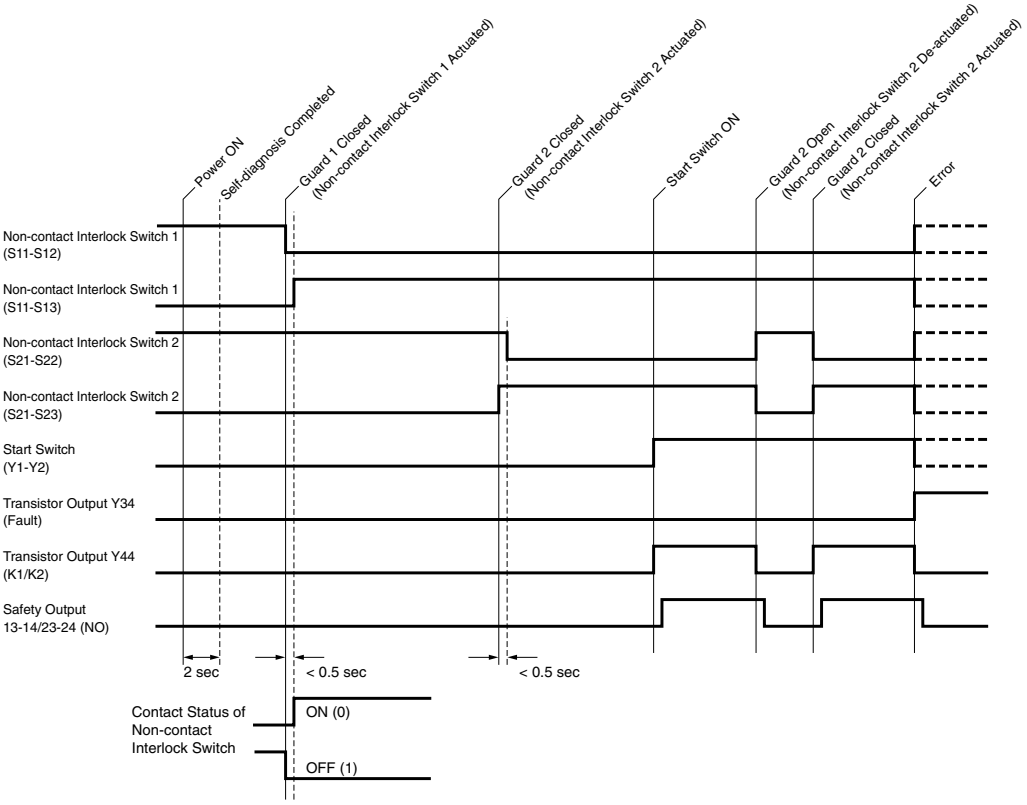
Causes of Fault LED Indication

LED2: Fault	Fault Type	Fault Cause	Measures
	Internal Fault	Fault of the internal circuit	Replace the safety relay module.
	External Fault	Short circuit of the +24V power supply and input terminal	Remove the short circuit and reboot.
	External Fault	Short-circuit of the non-contact interlock switch wiring	Correct the wiring of the non-contact interlock switch and reboot.
	Synchronization time excess of switch contact input	Synchronization for the NO contact and NC contact of the non-contact interlock switch (HS7A) is 0.5 seconds or longer.	Open and close the door again.
		Fault of the non-contact interlock switch (HS7A)	Replace the non-contact interlock switch.

The HR1S-DM terminal block can be removed and installed as shown, allowing for easy installation and replacement of modules.



HR1S-DM Operation Chart
When Using the Emergency Stop Switch



Safety Relay HR1S-ATE

Key features:

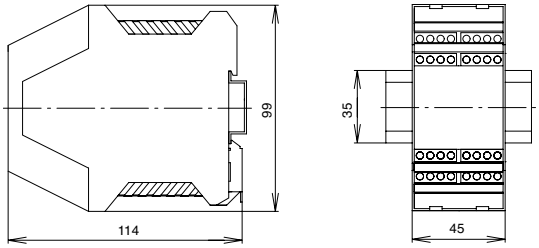
- EN ISO 13849-1 performance level e, safety category 4 compliant, and EN 62061 safety integrity level 3
- Integrated and removable teminal styles available
- Compact design: 45 mm in width
- Time delay outputs: 3NO
- Auxiliary output enables power supply monitoring, inputs (2 channels), and a time delay output
- Environmentally friendly, RoHs directive compliant
- UL Listed, CSA certified, TÜV NORD approved

Part Numbers

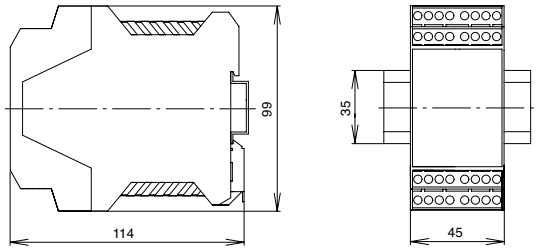
Part Number	Terminal Style
HR1S-ATE5110	Integrated Terminal Block
HR1S-ATE5110P	Removable Terminal Block

Dimensions (mm)

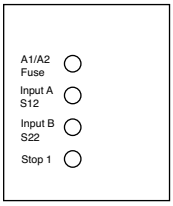
HR1S-ATE5110 Integrated Terminal Type



HR1S-ATE5110P Removable Terminal Type



LED Indicator



A1/A2 Fuse: Turns on when power circuit is normal.
Input A S12: Turns on when S11–S12 is closed.
Input B S22: Turns on when S21–S22 is closed.
Stop1: Turns on when the time-delay output circuits 57-58, 67-68, and 77-78 are closed.

Specifications

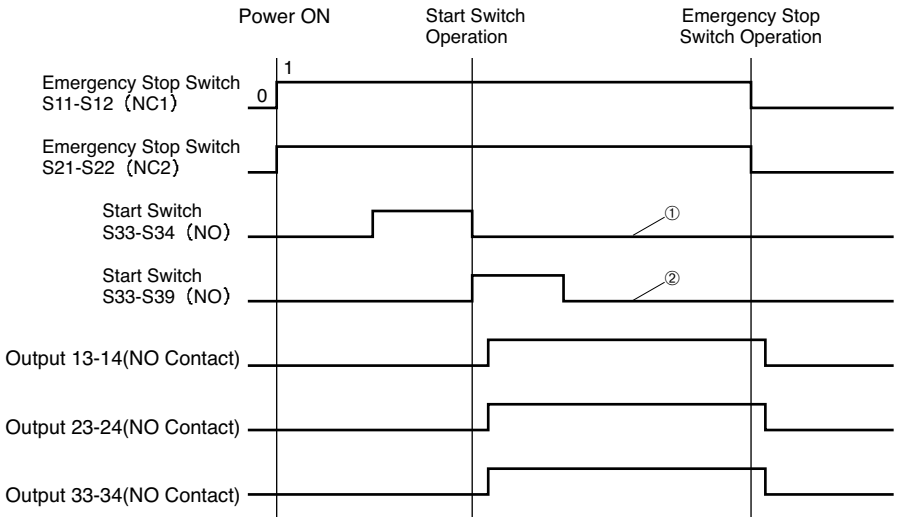
Applicable Standards			EN 60204-1: 2007, EN 60947-1: 2007, EN 60947-5-1:2004, EN 61000-6-2: 2005 EN 61000-6-4: 2007, EN 62061: 2005 EN ISO 13849-1: 2008, EN ISO 13849-2: 2008
Applicable Standards for Use			EN 60204-1: 2006 EN ISO 13850: 2008
Performance level (PL)			e (EN ISO 13849-1)
Safety Category			4 (EN ISO 13849-1)
Safety Integrity Level (SIL)			3 (EN 62061)
Stop Category			0, 1 (EN 60204-1) (Note)
Operating Temperature			–10 to +55°C (no freezing)
Relative Humidity			30 to 85% RH (no condensation)
Impulse Withstand Voltage			4 kV (IEC 60947-5-1)
Shock Resistance			150 m/s², 11m sec, 3 shocks in each 3 axes
Vibration Resistance			10 to 60 Hz, amplitude 0.35 mm 60 to 150 Hz, acceleration 50 m/s²
Degree of Protection			Terminal: IP20 Enclosure: IP40
Rated Voltage			24V AC –20% +10% 24V DC –20% +20%
Power Consumption			24V AC: 8 VA max. 24V DC: 4W max.
Overcurrent Protection			Built-in, electronic
Minimal Applicable Load			17V DC / 10 mA (initial value)
Response Time			ON to OFF: 20 ms max. (instantaneous output)
Overvoltage Category			III
Pollution Degree			2
Rated Insulation Voltage			300V Ac
No of Outputs	Safety Circuit		2NO
	Time-delay Circuit		3NO
	Auxilliary Circuit	Contact	None
		Transistor	4
Output Contact Ratings	Safety Circuit	AC15	C300 (230V AC / Ie=0.75A)
		DC13	24V DC / Ie=1A
	Time-delay Circuit	AC15	C300 (230V AC/ Ie=0.75A)
		DC13	24V DC / Ie=1A
		Preset Time	0, 0.5, 1, 2, 4, 6, 8, 10, 15, 20, 25, 30 sec.
	Auxilliary Circuit		24V DC / 20 mA (PNP)
Mechanical Durability			10,000,000 operations
Electrical Durability			See page XX
Rated Current			Total output: 8A max. 1 output 4A max.
Wire Size		HR1S-ATE5110	Single wire: 0.2 to 2.5 mm² max. (24~14 AWG) Multiple wires: 0.14 to 0.75 mm² max.
		HR1S-ATE5110P	Single wire: 0.2 to 2.5 mm² max.(24~14 AWG) Multiple wires: 0.2 to 1.5 mm² max.
Weight (approx.)			280g

Note: Safety output contact — Stop category 0
Time-delay output contact — Stop category 1

Use a 4A fuse (Type gG) for power protection.Use a 6A fuse (Type gG) for safety output protection.
Use a 4A fuse (Type gG) for time-delay output and auxiliary output protection.

HR1S-ATE Wiring Diagram

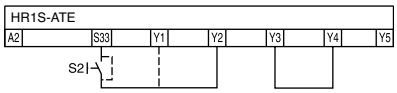
Safety Category 4 (3) Circuit (using an emergency stop switch) (Note)



Safety category is achieved by the entire control system. Take the connected safety equipment and wiring into consideration.

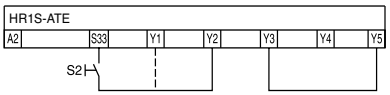
When not monitoring the start switch

(Y3-Y4 short-circuited)
(automatic start when S33-Y2 is short-circuited)



When monitoring the start switch

(Y3-Y5 short-circuited)



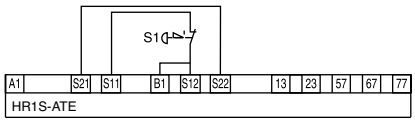
1. When monitoring the start switch, starts when switched off (default setting/recommended)
2. When monitoring the start switch, starts when switched on
3. Outputs must be fused (see the instruction manual for maximum fuse size)
4. To PLC, etc.

Note: When using off-delay output, safety category becomes 3.

S1 = Emergency stop switch with 2 NC contacts (recommended)
S2 = Start switch
ESC = External start conditions
Y1 (S33) – Y2 = Feedback loop

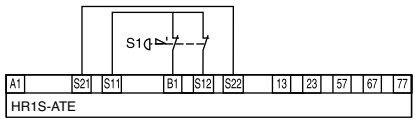
Emergency stop switch - Input 1 channel

When not detecting short-circuit (All failures such as short-circuit of emergency stop switch wiring not detected)

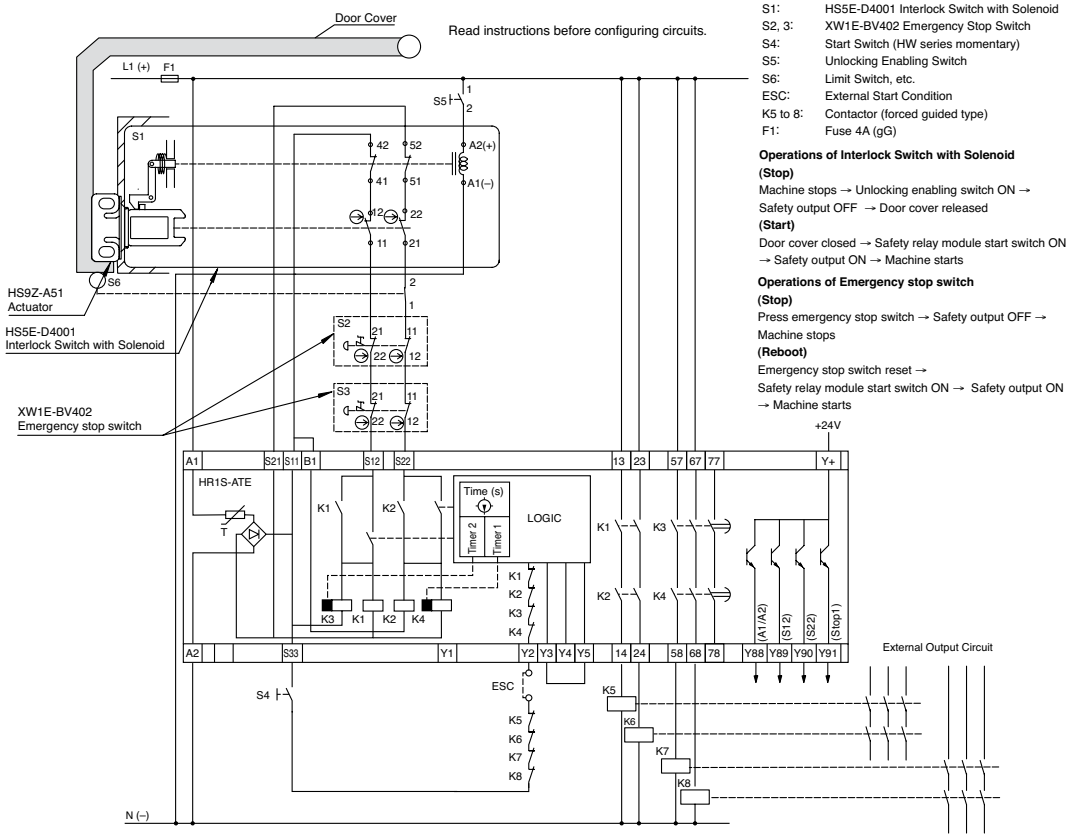


Emergency stop switch - Input 2 channels

When not detecting short-circuit(B1-S12 short-circuit not detected)



Safety Category 3 Example Circuit (using multiple emergency stop switches)

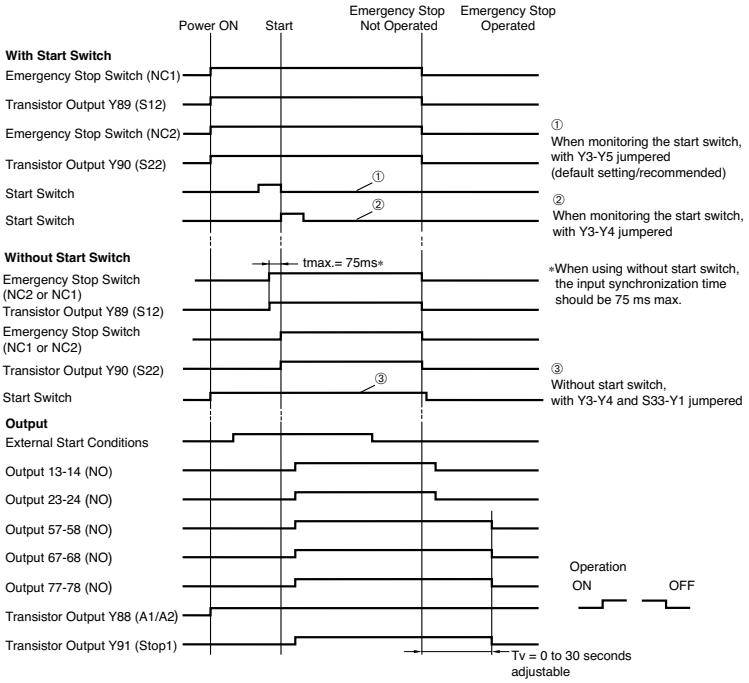


S1: HS5E-D4001 Interlock Switch with Solenoid
S2, 3: XW1E-BV402 Emergency Stop Switch
S4: Start Switch (HW series momentary)
S5: Unlocking Enabling Switch
S6: Limit Switch, etc.
ESC: External Start Condition
K5 to 8: Contactor (forced guided type)
F1: Fuse 4A (gG)

Operations of Interlock Switch with Solenoid
(Stop)
Machine stops → Unlocking enabling switch ON → Safety output OFF → Door cover released
(Start)
Door cover closed → Safety relay module start switch ON → Safety output ON → Machine starts

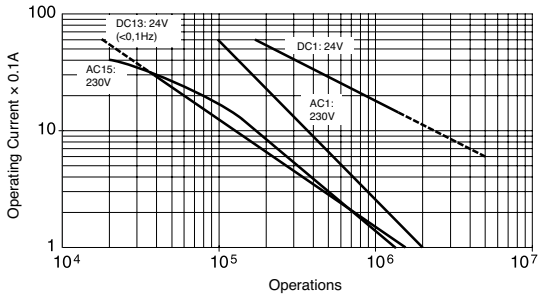
Operations of Emergency stop switch
(Stop)
Press emergency stop switch → Safety output OFF → Machine stops
(Reboot)
Emergency stop switch reset → Safety relay module start switch ON → Safety output ON → Machine starts

HR1S-ATE Operation Chart



Output Contact Electrical Life

(Safety Circuit, Time-delay Circuit, Auxilliary Circuit)



Residual Risk (En ISO/ISO12100-1)

The wiring diagrams on previous page have been tested under actual operating conditions. The HR1S-ATE safety relay module can be used in a safety circuit by connecting to safety equipment compliant to applicable standards. Consider residual risk in the following circumstances:

a) When it is necessary to modify the recommended circuit and if added/modified components are not properly integrated into the control circuit.

b) When applicable standards of machine operation are not observed, or when the machine is not adjusted or maintained properly (adhere to a strict maintenance schedule).

c) When the contacts of relays and contactors for connected with safety outputs are not forced guided (compliant with EN 50205).