

Description

The HVR10 is a hybrid powerful high end high voltage relay in a compact design. It combines physical isolation of high voltages via an electro-mechanical contact and state-of-the-art semi-conductor technology.

The hybrid, arc-free switching system allows reliable disconnection, even in the event of an overload, of up to 2 megawatts – 2,000 A/ 1,000 V. The HVR10 withstands high short circuit currents up to 5,000 A until the fast HV-fuse trips. The fist-sized unit can switch and permanently process 300 A at 900 V up to 50,000 times, arc-free and wear-free. The innovative self-monitoring function immediately signals critical operating conditions to the controlgear.



Benefits

- Reliable disconnection even in critical conditions up to 2,000 A at 1,000 V
- High protection of the on-board electrical system through integral fault detection and indication
- Long life span through low-arc switching operation

Target industries

- All utility vehicles, e.g. buses, trucks, construction machinery, specialty vehicles, mining vehicles etc.
- Test benches

Approvals

Approval authority	Logo	Directive	Rated voltage
KBA	10R-058905	ECE-R 10	900 V

Compliances



Features

- Continuous current capacity of 300 A at 25 °C or 250 A at 85 °C.
- The rupture capacity of up to 2000 A at 1000 V is valid for both current directions without restrictions. It is therefore possible to lead even high charging currents over the relay.
- Very low current consumption in the ON condition of typically 0.2 W (12 V * 18 mA) due to a bistable drive, which only draws power from the supply when the switching status changes.
- For a short period of time, the HVR10 can carry up to 5000 A (25 ms) and facilitates the co-ordination with a suitable HV fuse.
- The switching status of the mechanical contact system as well as the current rise upon switch-on operation is continuously monitored. This allows information of the control unit about critical operating conditions.
- The hybrid switching concept uses an electronic bypass that successfully suppresses the arc, thus significantly reducing the thermal load of the mechanical contact system.

Link to HVR10 video: <https://bit.ly/2X5lFvd>



Applications

The HVR10 was mainly designed as a main relay for utility vehicles with electrical power train, also for voltages beyond the 450 V system voltage. It is especially suitable for vehicles where reliability and availability are at a premium.

Technical data (25 °C)

Interfaces load circuit

Cable connection	M10 terminal studs (stainless steel A2)
Tightening torque	15 Nm
Accessories	washer to ISO 7092 A4 hexnut to ISO 4035 A4
Caution	Cable lug must only be mounted/tightened max. 5 times.

Performance data of hybrid contact system:

Terminals	88 und 88a	bidirectional
Preferential direction		none
Contact configuration in the load circuit	1-pole make contact ¹ (normally open)	
Rated voltage	DC 48 V up to 900 V ²	
Current ratings at 25°C ⁵	300 A	≥ 95 mm ² cable cross section
Rated current at 85 °C ⁵	250 A	≥ 95 mm ² cable cross section
Intermittent overcurrent ^{4, 5}	420 A 780 A 2,400 A 5,000 A for approx. 25 ms	for approx. 1,000 s for approx. 10 s for approx. 1 s
Mechanical cycles	150,000	power-off
Switching cycles »tough real-case«	50,000	switch-on at 300 A and 50 V switch-off at 50 A and 900 V
Max. switching frequency	1 Hz per day	typically 10 operations
Rupture capacity at 1000 V	2,000 A 1,300 A	min. 3 x break operations (τ = L/R = 0.6 ms) min. 3 x break operations (τ = L/R = 1.0 ms)
Switch-on capacity at 1000 V	1,000 A	min. 3 x make operations (τ = L/R = 1.0 ms)
Recommended fuse	D72SG120V420QF by Mersen or similar	
ON time	< 90 ms	
OFF time	approx. 10 ms	
Voltage drop ^{4, 5}	< 100 mV at 300 A	

Insulation capacity of load circuit

Voltage supply	DC 4,000 V at 3 mA between open main contacts DC 4,000 V at 3 mA between load circuit and control circuit	
Overvoltage category	1 (to DIN EN 60664)	
Pollution degree (DIN EN 60664)	2 for main terminals	2 for control terminals

¹ The HVR10 behaves like a monostable relay as long as the supply voltage is ensured.

² Arc suppression intervenes from a voltage of approx. 25 V.

³ See safety-relevant functions - make operation on a present short circuit.

⁴ When new.

⁵ Cannot be maintained when contact closed at no load.
Min. current 1 A

Technical data (25 °C)

Environmental tests

Temperature range (in operation)	-40 °C ... +85 °C
Temperature range (in storage)	-40 °C ... +85 °C
Max. altitude	2,000 m
Max. humidity	85% RH
Vibration	5.9 g (RMS value in all directions)
Shock resistance in ON condition	40 g (11 ms, half-sine)
Shock resistance in OFF condition	20 g (11 ms, half-sine)
Degree of protection	against dust and water (to ISO 20653) IP5K0 (all mounting positions) IP00 (terminals of load side) IP6K9K (TE connection of control cable)
Chemical resistance	battery acid, interior cleaner/cockpit spray, glass cleaner, acetone, cleaner containing ammonium, spirit / ethanol, sweat, cosmetic products (e.g. cream), cola, cream, milk

Other

Recommended mounting attitude	upright (terminal studs for cable lugs point upwards) – do not mount upside down!
Mounting option	holes for M5 screws with compression limiter max. tightening torque 6 Nm
Housing material	PA66, V0 flammability rating
Mass	approx. 550 g
Size of frame	90 mm x 87 mm x 80 mm

Instructions for use of the drive

The HVR10 has an energy-efficient bistable drive. Therefore, it only consumes typically 0.2 W (12 V * 18 mA). Only when changing the operating condition from ON to OFF and from OFF to ON will a current be required of max. 14 A for a very short time (30 ms). The HVR10 draws this current from the operating voltage supply and not from the controlgear.

In order to realise this energy-saving feature, it has to be tolerated that the HVR10 cannot change its switching status automatically as soon as the supply voltage is off. If your safety concept is based on an automatic opening of the high voltage relay in the event of an accident, we recommend to use a conventional monostable high voltage relay in the minus path.

This will make the entire system significantly more robust because the HVR10 switches the power in the plus path and the cheaper mechanical relay only follows in the minus path.

Ordering information

Type

HVR10 High voltage relay

Protection (characteristic curve)

N0 no protective function

Design

C1 compact

Terminal design / control cable

G1 M10 terminal studs/Tyco connector (MQS)

Load and control

BS BSS (both side switch)

Housing colour

01 black

02 orange

System voltage

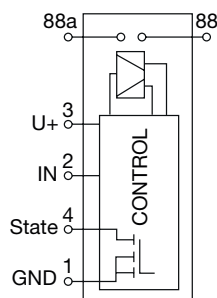
D9 DC 900 V

Current ratings (at 25°C)

300 A

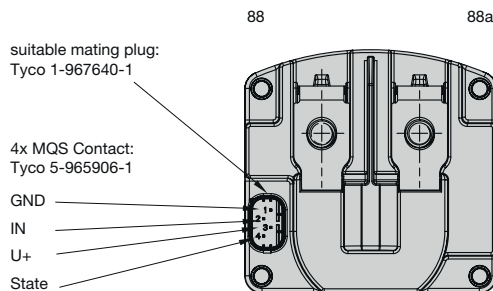
HVR10 - N0 C1 G1-BS 01 D9 - 300 A ordering example

Schematic diagram



Pin assignment:

Terminals



PIN 1	GND	Mass
Potential	0 V	

PIN 2	Rated current	Control input
Control voltage	0 V... 32 V	
OFF	0 V... 5 V	
ON	9 V... 32 V	
Current consumption	< 3.5 mA	internal 10kOHM resistor
Reverse polarity protection	yes	

PIN 3	U+	Operating voltage
Rated voltage	12 V/24 V	
Voltage range	10 V... 32 V	fully functional
Current consumption	< 3 mA	at control voltage OFF
	< 18 mA	at control voltage ON
	< 14 A for 30 ms	when the switching status changes
	< 1 A for 200 ms	after change of switching status, driving power is drawn from PIN3, not from the controlgear.
Reverse polarity protection	yes	

PIN 4	State	Status or feedback signal
Function	0 V... 1 V	status OK
	open collector – high-resistance	status NOK A specific connection to the controlgear was selected to allow detection of wire break in the status line. For this purpose, a pull-up resistor against +U _B must be activated at the input of the controlgear.
Voltage range	0 V ... 32 V	
Current	< 100 mA	
Internal resistance	approx. 0.5 Ohm	
Reverse polarity protection	NO	
Leakage current	≤ 1µA	

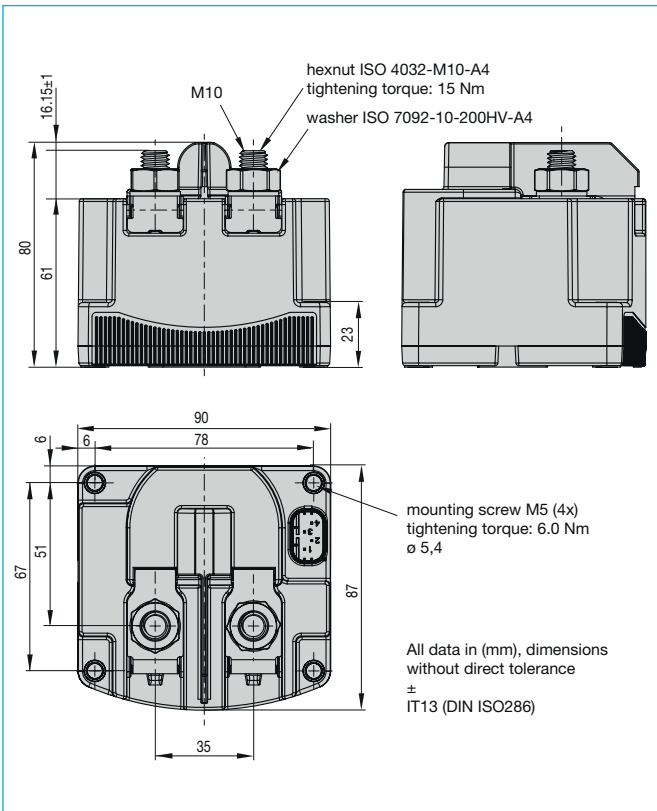
Connector components

- 1 x housing TE part number 1-967640-1
- 4 x contacts TE part number 5-965906-1 for cable 0.5 ... 0.75 mm²
- 4 x seals TE part number -965906-1 for cable 1.4 ... 1.9 mm²

These components can be ordered from distributors.

All information and data given on our products are accurate and reliable to the best of our knowledge, but E-T-A does not accept any responsibility for the use in applications which are not in accordance with the present specification. E-T-A reserves the right to change specifications at any time in the interest of improved design, performance and cost effectiveness. Dimensions subject to change without notice. Please enquire for the latest dimensional drawing with tolerances if required. All dimensions, data, pictures and descriptions are for information only and are not binding. Amendments, errors and omissions excepted. Ordering codes of the products may differ from their marking.

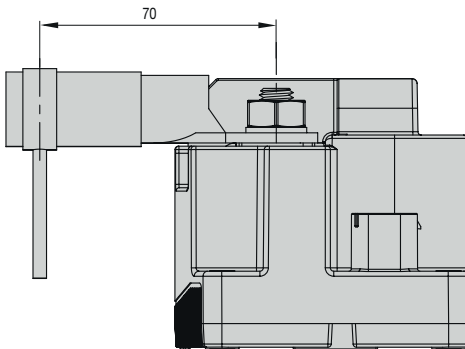
Dimensions HVR10



Note

Mounting note

The connecting cables must be connected within 7 cm of the axle of the screw connection and must be firmly fixed with suitable means. (Strong mechanical stress is not permissible).



Typical switch-on operation

1. Apply operating voltage to PIN 1 and PIN 3. This voltage supply must continuously be ensured. The energy for the drive will be drawn from this power supply and not from the controlgear.
2. The status output indicates OK by drawing the HIGH level from the controlgear to the ground on PIN 4 (state).
3. As soon as a HIGH level is applied to PIN 2 ($> 9\text{ V}$), the HVR10 switches on the load circuit.
4. The status output continues to indicate OK by drawing the HIGH level from the controlgear to the ground on PIN 4 (state).

Typical switch-off operation

1. As soon as a LOW level is applied to PIN 2 ($< 5\text{ V}$), the HVR10 switches the load circuit off.
2. The status output continues to indicate OK by drawing the HIGH level from the controlgear to the ground on PIN 4 (state).
3. The operating voltage can be switched off after $> 100\text{ ms}$, e.g. when the vehicle is parked.

Safety-relevant functions

- **Make operation onto an existing short circuit** We expect that the HVR10 is operated in a pre-charge jig. Therefore, it is probable that there is a defect when the current rises to 1000 A within 1 ms when switching on. The HVR10 monitors the current rise during switch-on operation. If a short circuit is suspected, the mechanical contact system will not close in the first place. The semi-conductor bypass will open the load circuit and the controlgear is informed about the fault via the feedback signal. The device is reset when the control signal is set to »low« and back to »high« again.
- **Monitoring of switching status:** By means of a light barrier, the position of the mechanical main contact is continuously monitored. If the desired position of the mechanical main contact cannot be established, the HVR10 will signal this critical operating condition.
- The housing is also available in the high voltage warning colour (orange, RAL 2003).
- The HVR10 was designed and manufactured to IATF 16949 and thus meets the ASIL-Level-QM. It was designed as a standard catalogue product. Due to special safety requirements from customer side, we are unable to indicate a higher level.
- The HVR10 itself does not have a fail-safe element.
- The HVR10 does not require any maintenance work.
- Internal monitoring detects and signals the following conditions/ errors:
 - Switch-on command cannot be carried out
 - Switch-off command cannot be carried out
 - Operating voltage too low, lower than 10 V
 - Internal fault of microcontroller
 - Cable to controlgear interrupted
 - Cable to power supply interrupted
 - Unreliable frequent switching operation within a short time (temperature management)

Safety Indication



- The HVR10 has an energy-efficient bistable drive system. This drive system does not open automatically when the supply voltage is interrupted. Please observe during installation that the main contact could be closed. Please test the relay function before connecting the high voltage load circuit.
- Installation and start-up only be qualified personnel.
- Please observe the following five safety rules:
 - switch off
 - secure against reset
 - check absence of voltage
 - ground and short-out
 - cover or shield adjacent live parts
- Read the safety instructions carefully and keep them for later usage.
- Danger to life from electric shock.
- Operate only within technical specification and specified environmental conditions (Please observe data sheet, otherwise risk of personal injury).
- The HVR10 must not be used in areas where an explosive atmosphere may occur.
- The terminals' temperature must not exceed 100 °C continuously.
- We recommend to continuously monitor the temperature of the load circuit terminals.
- Caution: Terminals can get hot (> 50 °C - danger of burns).
- Leave to cool before touching.
- Touching live parts can cause serious injuries (the device has unprotected live parts, 1,000 V).
- Caution: The switching operation may cause voltage peaks up to 2,500 V.
- After disconnection of overcurrents, the device may be no longer usable. Please check in advance or replace.
- During switching operations, the device may cause electrical and/or magnetic interferences.
- Aggressive media can damage the device externally. Damages devices must be replaced.
- For proper operation, the device must be mounted/closed by means of four M5 screws.
- Do not mount side-by-side, in particular not with other heat sources. Heat accumulation must be avoided.
- Before switching high voltage, please switch the device repeatedly without activated main circuit to test proper wiring of the control side (observe max. peak currents).
- The device is maintenance-free over the entire life span. Endurance depends on the application.
- Do not drop.
- Damaged devices must be replaced immediately. E-T-A does not accept any warranty for damaged devices that are put into operation.
- Please do not further use in the event of malfunction.

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