



Impulsionando a Inovação

THERMAL RELAY



THERMAL RELAY

1. Overview and Highlights

Description

The HVEX thermal protection relay is a complete solution for thermal monitoring and protection of transformers (dry-type and oil-filled) and electrical panels.

Key Features:

- Multichannel Measurement: 4 independent temperature measurement channels;
- Programmable Protection: Individual adjustment of alarm and trip levels per channel;
- Relay Outputs: Programmable digital contacts for protection and signaling;
- Industrial Communication: Modbus RTU interface for full parameterization and integration with SCADA/PLC;
- Data Logger: Event and history logging via memory card.



Features

- 4 measurement channels for RTD/PT100 (3-wire) sensors with active cable compensation;
- Operating range from -50 °C to +200 °C with a 24-bit ratiometric A/D converter;
- 5 fully programmable relay outputs for Alarm, Trip, Fail-Safe, and Fan Control (Fan 1 and Fan 2) functions. Supports voltages up to 250 VAC and 30 VDC and currents up to 5 A;
- Modbus RTU Slave industrial communication interface for integration with PLCs and SCADA systems;
- Isolated analog output, configurable as voltage (0–10 V) or current (0–20 mA / 4–20 mA);
- MicroSD card data logger with continuous temperature recording and event history;
- Real-Time Clock (RTC) with battery for time-stamping of failure events;
- Front HMI with a 4-digit 7-segment LED display, intuitive navigation, and password protection;
- Modular architecture with galvanic isolation between the analog, digital, and power blocks;
- Complete Thermal Control with 5 Relay Outputs: Independent relays for Alarm, Trip, and Internal Failure (Fail-Safe), plus 2 outputs dedicated to activating ventilation/cooling

2. Detailed Technical Specifications

Temperature Reading

- Number of Channels: 4 independent channels;
- Supported Sensor: RTD/PT100 (3-wire connection);
- Cable Compensation: Automatic via firmware;
- Measurement Range: -50 °C to +200 °C;
- Resolution / ADC: 24 bits in ratiometric mode with a 1°C precision reference;
- Signal Processing: Multi-stage RC filter, 60 Hz noise mitigation;
- Input Protection: ESD and surge protection via TVS array and current limiting via series resistors;
- Galvanic Isolation: Digital isolation between the sensor acquisition stage and the central unit.

Relay Outputs

- Number of Outputs: 5 highly reliable electromechanical relays;
- Contact Load Capacity: Maximum of 5 A @ 250 VAC or 5 A @ 30 VDC (for resistive loads). Note: To drive larger loads, such as direct-drive motors or large panels, the use of auxiliary contactors is recommended;
- Terminal (Contact) Configuration:
 - Relays 1, 2, and 3:** Fully independent and isolated terminals (Common, Normally Open, and Normally Closed);
 - Relays 4 and 5:** Normally Open (NO) terminals sharing a common bus.
- Programmable Functions (Factory Default):
 - Relay 1:** Fail-Safe (Signaling of internal failure or power loss);
Application Note: This relay operates in *Normally Energized* mode. During normal, fault-free operation, the contact remains closed. To signal a fault or loss of power to the equipment, the NC (Normally Closed) contact must be used.
 - Relay 2:** Trip (Main Shutdown);
 - Relay 3:** Alarm (High-Temperature Warning);
 - Relays 4 and 5:** Forced Ventilation Control;
- Safety: Trip logic protected against industrial electromagnetic noise, ensuring that no “false trips” (accidental tripping) occur in noisy substations or panels.

Relayed Analog Output

- Channels: 1 galvanically isolated analog output;
- Selectable Electrical Modes:
 - Voltage: 0 to 10 V;
 - Current: 0 to 20 mA or 4 to 20 mA.
- Reference Variable: Programmable for Channel 1, Channel 2, Channel 3, Channel 4 (Ambient), or Highest Active Temperature (HIGH);
- Temperature Range: Minimum (LOW) and Maximum (HIGH) adjustable between 0 °C and 200 °C;
- Output Diagnostics via Modbus: Thermal protection and error detection, load error (short circuit in voltage mode), and open circuit (broken wire in current mode).

Serial Communication Interface

- Physical Standard: Differential RS485 (2 wires + reference);
- Connection: Terminals A (Data+), B (Data-) and GND (Shield/Ground);
- Communication Protocol: Modbus RTU (Slave mode);
- Configurable Baud Rates: 4800, 9600, or 19200 bps;
- Address Range: 1 to 31 (configurable);

Integration Note: To connect to computers or PLCs without a native serial port, an external converter is required (e.g., USB/RS485 converter or Modbus RTU to Modbus TCP gateway).

Data Logger

- Continuous Channel Logging: Records to the CHANNELS.TXT file at a programmable interval of 1 to 15 minutes;
- Event Log: Immediate recording to the EVENTS.TXT file for changes in Alarm, Trip, and Failure statuses, as well as fan activation;
- Time Stamping (Date/Time): Internal real-time clock;
- Software Integration (Relay Config): The .TXT files generated on the MicroSD card can be easily imported into the Temperature Relay software, allowing for the visual plotting of temperature trend graphs and the automated generation of statistical reports on events and failures.

3. Modbus RTU Data Logger Map Table

Register Map with Read Permission - MODBUS		
Address	Variable Function	Unit / Correspondence
0 (40000)	Flag Indicating an Error in the Analog Output	Bits 0 through 2 = 0: Normal Operation (No errors in the analog output) Bit 0 = 1: Thermal Error (EFOT): Overheating of the internal chip driver. Bit 1 = 1: Load/Voltage Error (EFLD): Load resistance too low or short circuit in Voltage mode (0–10 V). Bit 2 = 1: Current Error (EFCM): Load resistance too high or open loop/broken wire in Current mode (0–20 mA / 4–20 mA).
71 (40071)	Alarm Indicator Flag	0 = No temperature has exceeded the set alarm limit; 1 = One or more channels have reached the alarm temperature.
72 (40072)	Trip Indicator Flag	0 = No temperature has exceeded the defined trip limit; 1 = One or more channels have reached the trip temperature.
73 (40073)	Internal Failure (Fail-Safe) Indicator Flag	0 = No internal faults; Bit 1 = 1: Failure in the I2C connection between boards (Master/Slave); Bit 2 = 1: PT100 sensor failure (open circuit or short circuit).
74 (40074)	Fan 1 Relay Status Indicator Flag	0 = Fan 1 off; 1 = Fan 1 active (Reference channel temperature exceeded the set limit). 2 = Fan 1 active (Cyclic test - TGym)
75 (40075)	Fan 2 Relay Status Indicator Flag	0 = Fan 2 off; 1 = Fan 2 active (Reference channel temperature exceeded the set limit). 2 = Fan 2 active (Cyclic test - TGym)
84 (40084)	Channel 1 Temperature	0–200 (value in °C)
85 (40085)	Channel 2 Temperature	0–200 (value in °C)
86 (40086)	Channel 3 Temperature	0–200 (value in °C)
87 (40087)	Channel 4 Temperature (Ambient)	0–200 (value in °C)
88 (40088)	Highest temperature recorded among active channels	0–200 (value in °C)
89 (40089)	Alarm Relay Status	0 = Not triggered; 1 = Tripped.
90 (40090)	Trip Relay Status	0 = Not Tripped; 1 = Tripped.

91 (40091)	Internal Fault (Fail-Safe) Relay Status	0 = Not tripped; 1 = Activated. *The relay set to <i>Fail Safe</i> is, by default, always activated. In the event of an internal fault, it is automatically deactivated (common in the case of a short circuit with NC contacts)
92 (40092)	Fan 1 Relay Status	0 = Not activated; 1 = Engaged.
93 (40093)	Fan 2 Relay Status	0 = Not activated; 1 = Activated.

Map of Registers with Read and Write Permissions in MODBUS		
Address	Variable Function	Unit / Correspondence
1 (40001)	Defines which channel is the reference for the analog output	6 = Channel 1; 7 = Channel 2; 8 = Channel 3; 9 = Channel 4 (Ambient); 10 = Highest temperature among active channels.
2 (40002)	Sets the operating range of the analog output	11 = 0–10 V; 12 = 0–20 mA; 13 = 4–20 mA;
3 (40003)	Lower limit of the analog output. Sets the temperature (in °C) corresponding to the minimum electrical level of the physical output (0 V, 0 mA, or 4 mA, depending on the configured range)	0–199 (value in °C). Factory Default = 0 °C.
4 (40004)	Upper limit of the analog output. Defines the temperature (in °C) corresponding to the maximum electrical level of the physical output (10 V or 20 mA, depending on the configured range)	1 - 200 (value in °C). Factory Default = 100.
5 (40005)	Monitoring interval for temperature channels on the SD card	1 to 15 (value in minutes). Factory Default = 1 minute.
6 (40006)	SD Card Monitoring Mode	19 = Monitors Temperature Channels; 20 = Monitors Events (Trip, Alarm, etc.); 21 = Monitors Events and Channels Simultaneously.
7 (40007)	Modbus Communication Address (ID)	1–31 Factory Default = 1.
8 (40008)	Modbus Communication Speed	14 = 4800; 15 = 9600; 16 = 19,200.
10 (40010)	Enable Temperature Channel 1	0 = Disabled; 1 = Enabled.
12(40012)	Temperature Value for Channel 1 That Activates the Alarm Relay	0–200 (value in °C). Factory Default = 75.
13 (40013)	Channel 1 Temperature Value That Activates the Trip Relay	0–200 (value in °C). Factory Default = 100.
14 (40014)	Enable Temperature Channel 2	0 = Disabled; 1 = Enabled.
16 (40016)	Temperature Value for Channel 2 That Activates the Alarm Relay	0–200 (value in °C); Factory Default = 75;

17 (40017)	Channel 2 Temperature Value That Activates the Trip Relay	0–200 (value in °C); Factory Default = 100;
18 (40018)	Enable Temperature Channel 3	0 = Disabled; 1 = Enabled.
20 (40020)	Temperature Value for Channel 3 That Activates the Alarm Relay	0–200 (value in °C). Factory Default = 75.
21 (40021)	Channel 3 Temperature Value That Activates the Trip Relay	0–200 (value in °C). Factory Default = 100.
22 (40022)	Enable Temperature Channel 4	0 = Disabled; 1 = Enabled.
24 (40024)	Temperature Value for Channel 4 That Activates the Alarm Relay	0 to 200 (value in °C). Factory Default = 75.
25 (40025)	Channel 4 Temperature Value That Activates the Trip Relay	0 to 200 (value in °C). Factory Default = 100.
42 (40042)	Date Format (Year)	2000–2099
43 (40043)	Date Field (Month)	1 - 12
44 (40044)	Date Record (Day)	1 - 31
45 (40045)	Time Record (Hour)	0 - 23
46 (40046)	Time Record (Minutes)	0 - 59
47 (40047)	Time Recording (Seconds)	0 - 59
48 (40048)	Date Entry (Day of the Week)	22 = Monday; 23 = Tuesday; 24 = Wednesday; 25 = Thursday; 26 = Friday; 27 = Saturday; 28 = Sunday.
49 (40049)	Password for Accessing Settings on the HMI	0 - 9999 Factory Default = 1000.
51 (40051)	Fan 1 Relay Drive Reference Channel	29 = Highest Temperature Among Active Channels; 30 = Channel 4 (Ambient); 31 = Channel 1; 32 = Channel 2; 33 = Channel 3.
52 (40052)	Fan 1 Relay Activation Temperature	0–200 (value in °C). Factory Default = 70.
53 (40053)	Fan 1 Relay Deactivation Hysteresis	1–15 (value in °C). Factory Default = 10.
54 (40054)	Interval Between Fan 1 Cycle Tests	1–168 (value in hours). Factory Default = 24.
55 (40055)	Fan 2 Relay Drive Reference Channel	29 = Highest Temperature Among Active Channels; 30 = Channel 4 (Ambient); 31 = Channel 1; 32 = Channel 2; 33 = Channel 3.
56 (40056)	Fan 2 Relay Activation Temperature	0–200 (value in °C). Factory Default = 70.

57 (40057)	Fan 2 Relay Deactivation Hysteresis	1–15 (value in °C). Factory Default = 10.
58 (40058)	Interval Between Fan 2 Cycle Tests	1–168 (value in hours). Factory Default = 24.
59 (40059)	Assigns the Function of Relay 1	0 = Disabled; 1 = Alarm; 2 = Trip; 3 = Fail-Safe; 4 = Fan 1; 5 = Fan 2.
60 (40060)	Assigns the Function of Relay 2	0 = Disabled; 1 = Alarm; 2 = Trip; 3 = Fail-Safe; 4 = Fan 1; 5 = Fan 2.
61 (40061)	Assign Relay 3 Function	0 = Disabled; 1 = Alarm; 2 = Trip; 3 = Fail-Safe; 4 = Fan 1; 5 = Fan 2.
62 (40062)	Assigns the Function of Relay 4	0 = Disabled; 1 = Alarm; 2 = Trip; 4 = Fan 1; 5 = Fan 2. *Cannot be used as a Fail-Safe relay because there is no NO contact exposed on the connectors of board 201
63 (40063)	Assigns Relay 5 Function	0 = Disabled; 1 = Alarm; 2 = Trip; 4 = Fan 1; 5 = Fan 2. *Cannot be used as a Fail-Safe relay because there is no NC contact exposed on the connectors of board 201
70(40070)	Defines which channel's reading will be shown on the HMI displays	29 = Highest Temperature among Active Channels; 30 = Channel 4 (Ambient); 31 = Channel 1; 32 = Channel 2; 33 = Channel 3; 34 = Scan of All Active Channels (Scan).

4. Electrical and Mechanical Specifications

Power Supply

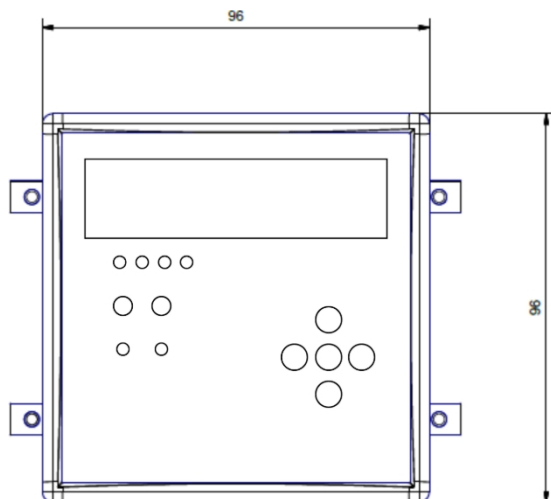
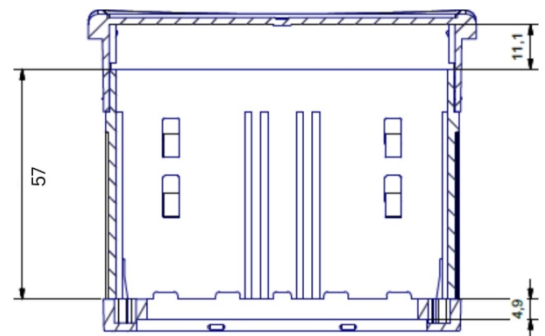
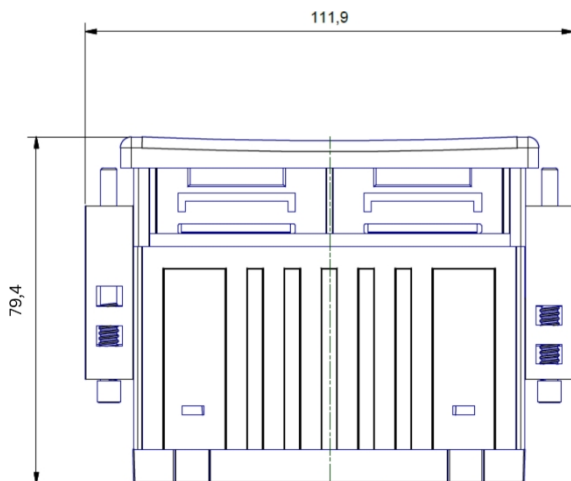
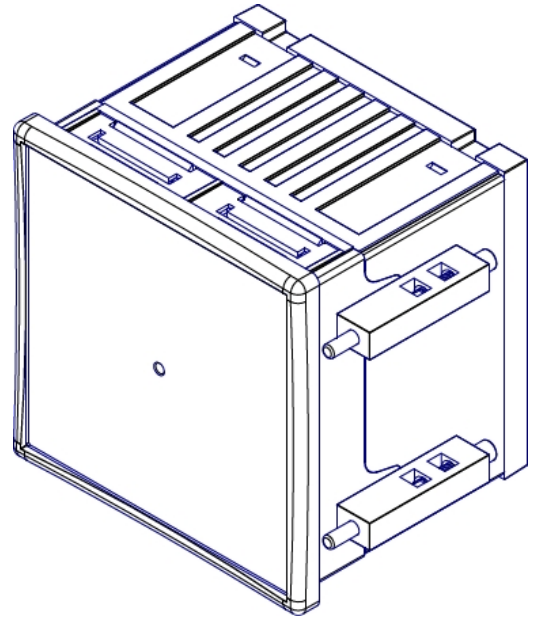
- Power Supply Range: 110 to 240 VAC;
0.25 A;
50/60 Hz;
- Maximum Power Consumption: <10 VA.

Operating Environmental Conditions

- Equipment operating temperature: 0°C to 70°C;
- Relative humidity: 5% to 95% non-condensing;
- Protection Rating: IP20 for the enclosure.

Mechanical Specifications

- External dimensions: 79.4 x 96 x 111.9 mm;
- Panel cutout: 96 x 96 mm;
- Approximate weight: 360 g;
- Mounting: 35 mm DIN rail.





Driving Innovation



☎ 35 3622-2699

✉ contato@hvex.com.br

🌐 www.hvex.com.br

📍 R. Ismael Pinto de Noronha, 86,
Nossa Sra. de Fatima, Itajubá-MG