



Hot-runner temperature control system HRC KS



- Compact control system with single-loop controllers**
- DPID control action with self-tuning (automatic or at set-point)**
- Start-up function, set-point lowering or raising (boost)**
- Sensor break and reversed-polarity monitoring**
- “Hold” function for output in case of sensor break**
- Monitoring of heating current and solid-state relay**
- Output switch-off in case of SSR short circuit**
- Simplest operation**
- Error messages in plain text for fast operator response**

PROFILE

The hot-runner control system HRC KS comes complete with temperature controllers and solid-state relays (SSR), completely wired in a robust tabletop housing. Cables with standard heavy-duty connectors are provided for direct connection to the hot-runner mould. A range of versions with 2 to 24 controllers (in steps of 2) ensures a precise match to the different requirements of hot-runner systems.

Standard features such as start-up function, self-tuning, set-point lowering (standby), set-point raising (boost), temperature alarm, heating current alarm, and SSR monitoring make the HRC KS ideally suited for temperature control of hot-runner moulds.

Because the HRC KS system is delivered with tried-and proven settings, commissioning and operation are particularly simple.

If necessary, the full flexibility of the KS 50 controllers can be used to match them to changing application conditions.

OPERATION

The master switch at the front of the housing is used to switch off the supply voltage for the entire unit and the connected heating elements.

Individual operation of the HRC controller

Only three robust keys are used for all settings and adjustments. Tactile feedback from the keys and an automatic increase in rate of change when a key is pressed for a longer period ensure fast and safe settings.

Clear operating concept and lockable parameter adjustment

All operating functions are user-friendly and clearly structured (Fig. 2) as follows:

Operating Level for process value display and set-point adjustment. Briefly pressing the selector key changes to display of heating current, and permits adjustment of the limiting current value. Pressing the key again changes the display to process value and heating current. Pressing the key a third time shows process value and output value.

Parameter Level for adjusting the required control parameters, limit values, etc.

Configuration Level for adjusting the controller functions.

When delivered, an internal switch in the HRC KS-system prevents unauthorized access to the Parameter and Configuration levels.

If the plug-in controller module is pulled forward, the switch can be operated to enable access.

DESCRIPTION

Start-up circuit

High-performance heating elements with magnesium oxide insulation must be heated slowly, to remove any humidity and to prevent destruction. With activated start-up circuit, the controller uses the adjusted start-up temperature (e.g. 40%) until reaching the starting set-point (e.g. 95°C). To protect the heating elements, the duty cycle is reduced to ¼ during start-up. The starting set-point (e.g. 95°C) is maintained during the selected start-up holding time. Subsequently, the controller uses main set-point W. The start-up circuit is activated automatically, if the process temperature is more than 40 K below the start-up set-point (e.g. ≤55 °C).

Set-point lowering (standby)

If the “Standby” switch is pressed, all the controllers are switched to a reduced set-point, which can be adjusted individually for each controller. The standby set-point can also be activated by means of an external signal, e.g. from the injection molder, via a special input.

Set-point raising (boost)

If the “Boost” switch is pressed, all the controllers are switched to a higher set-point (e.g. +30 K). The boost set-point can also be activated by means of an external signal. The boost temperature is switched off automatically after a defined time (safety cut-out), regardless of the switch position or the external signal.

Fig. 1 Front panel of KS50 HRC

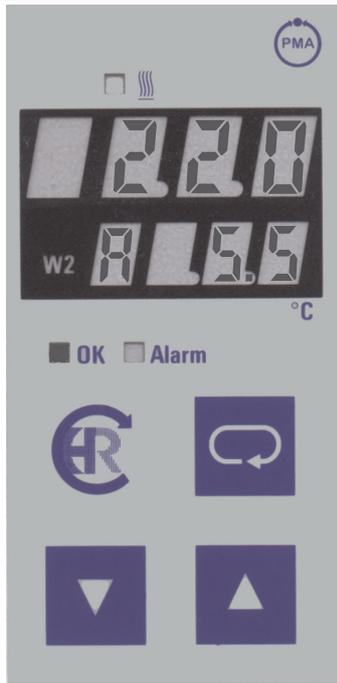
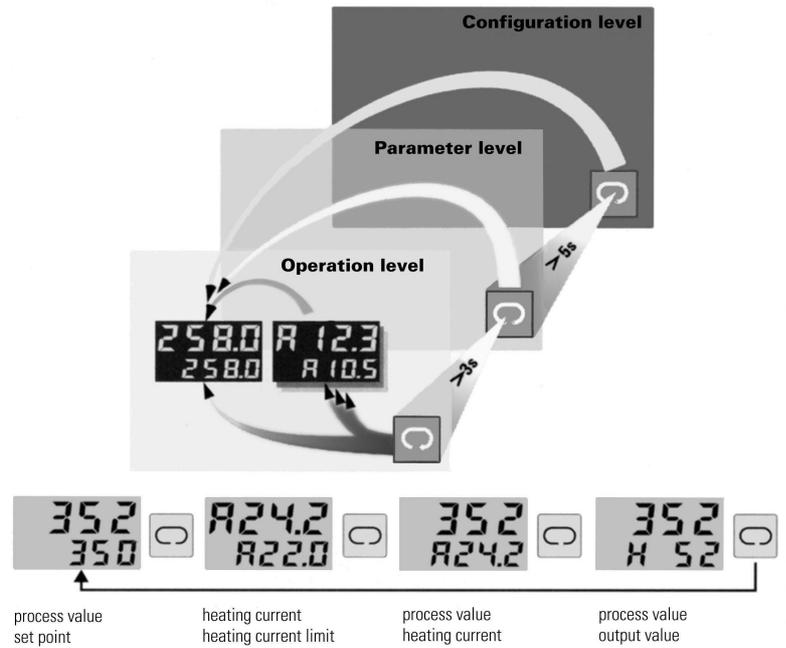


Fig. 2 Operation and display



Self-tuning

The function is fitted as standard for automatic determination of the best control parameters. Self-tuning is started either automatically after power up or on demand, and uses the delay time T_u and the max. rate of change V_{max} of the temperature control loop to calculate the optimum settings for fast line-out without overshoot. Self-tuning also works with the activated start-up function.

Disabled outputs

The controller outputs can be disabled by adjusting the set-point to "—" (all outputs de-energized).

Alarm functions

Alarm 1 can be configured as a relative temperature alarm, as an input circuit monitor, or as a heating current monitor. The alarm relays of the individual controllers are connected in parallel and are taken to the common alarm relay (Alarm 1 with switch-over contacts).

Temperature alarm

Each controller has a pre-set range of ± 10 K relative to set-point W as a "within-limits" tolerance band ($LCL = 10$ and $LCH = 10$). The relay is energized on alarm. During set-point changes, the alarm is suppressed.

Input circuit monitoring

In case of a fault in sensor or leads, the built-in monitor provides increased operational safety. The monitor is triggered on sensor break and with reversed polarity. The display shows "FbF" or "POL" respectively.

Output "hold" in case of sensor break

Controller output response to a triggered monitor is as follows: On sensor break, the mean output value is maintained ("hold" function). In this way, production can be continued in spite of the fault; the "hold" temperature is kept approximately constant. The HRC 50 shows "FbF" in the upper display, whilst the lower display shows the "hold" output value, which can be changed by the operator, if necessary.

Sensor break is also signalled by Alarm 1. Normal control is resumed automatically after sensor replacement.

The "hold" value is determined at 100 ms intervals, provided that the process value is within an adjustable response threshold (e.g. $X_w = \pm 1K$). After switching on the supply voltage again, or after re-configuration, the "hold" value is set to 0%. To prevent excessively high output values, with consequent overheating, the "hold" value can be limited.

Reversed sensor polarity

In case of reversed polarity, the upper display shows "POL", and the outputs are switched off. The yellow LED "Alarm 1" lights up if the temperature monitor detects an exceeded limit value, or a sensor break on one of the activated control loops (common alarm 1). The red LED "Alarm 2" lights up if the heating current monitor detects a fault in one of the activated control loops (common alarm 2).

The output signals (relay contacts) of the two common alarms are available at the rear connector.

Heating current display and alarm

HRC 50 controllers are fitted with a built-in current monitor. The heating current and the adjustable current limits are displayed in the Operating Level. The heating current alarm is triggered, if the controller energizes the heating element, but the current remains below the adjusted limit.

A red LED on the relevant controller and the yellow LED in the housing panel indicate a triggered heating current alarm. Alarm 1 activates a common alarm relay with a potential-free switchover contact.

Safety switch-off in case of SSR short circuit

Alarm 2 is triggered by a short-circuited SSR, and switches off the entire heating power to the hot runner via a heavy-duty contactor. Alarm 2 also activates a common alarm relay with a potential-free switchover contact. The supply to the controllers is not switched off, so that the error display "SSr" stays on.

Controller and positioner functions

For hot-runner control, the standard configuration of the HRC 50 is a two-point controller. Alternatively, it can be configured as a positioner (without sensor input). In case of a sensor break, the error display "FbF" is suppressed (see operating instructions for KS 50).

TECHNICAL DATA

Inputs

Thermocouples
Type L (can be configured for Type J to DIN IEC 584).
Display: in °C or °F (temperature-linear)
Display error: 1K ±1 digit
Input resistance: =1MΩ
TC break monitor: sensor current ≤1 μA, configurable output action.
Polarity monitoring: responds when input signal is 30 K below span start.
Temperature compensation: built in (sensor leads are taken to a multi-pin connector).

Outputs

Heating current outputs via solid-state relays.
Rating per load circuit:
≤16 A, 3300 W, 230 VAC (between L and N), resistive load.
Each SSR is protected by a super-fast 16 A cartridge fuse.
The load circuits are distributed among the three phases L1, L2 and L3. See Table 1 for max. permissible loads per phase. The load outputs are taken to a heavy-duty connector.

Power supply

Three-phase 400/230 VAC with neutral and safety earth.
Voltage tolerance: -15...+20%
Frequency: 48...62 Hz
Total power consumption: connected heating power plus approx. 150 VA
Version with 4 controllers:
Connecting cable 4m long, with CEE connector (16 A).
Version with 6 to 16 controllers:
Connecting cable 4m long, with CEE connector (16 A).
Version with >16 to 24 controllers:
Connecting cable 4m long with free ends.

Operation

One master switch controls the supply voltage for the entire unit and the connected heating elements.

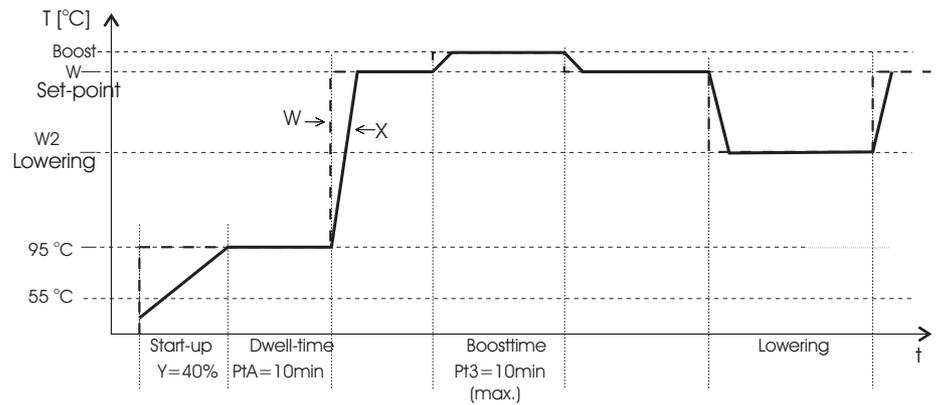
"Standby" switch activates a reduced (standby) set-point for each controller. The standby set-point can also be activated by means of an external signal.

"Boost" switch activates an increased set-point for each controller. The boost set-point can also be activated by means of an external signal.

Yellow LED "Alarm 1" lights up if an exceeded temperature, a sensor break, or a heating current alarm is detected.

Red LED "Alarm 2" lights up if a short-circuited SSR is detected.

Fig. 3 Start-up function, set-point lowering and boost



Control behaviour

Two-point DPID controller with 2 alarms, re-configurable as positioner.

Control parameters

Self-tuning or manually adjustable (see parameter adjustment table for KS 50)

Alarm functions

Alarms 1 and 2 configurable as:

- relative or absolute measurement value alarm,
- relative measurement value alarm with alarm suppression
- sensor break alarm
- heating current alarm
- SSR short circuit alarm

Output action is configurable: relay de-energized or energized on alarm.

Heating current monitoring

Display of heating current:
0...15,0 Arms with resistive load.
Display error: ±2,5% of display range
Heating current limit:
adjustable 0...15,0 A, acting on alarm output 2.

Alarm indication via red LED.

Monitoring for SSR short circuit:
Red LED on (residual current =0,2 A).

Set-point

Upper and lower limits of the set-point range are selectable within the measuring range limits.

Displays

Two red 4-digit LED displays.
Digit height: Process value X = 10 mm
Set-point W = 7,6 mm
Display range: 9999
LEDs for status display
Yellow W2: for set-point W2
LEDs for relay status
Yellow left: heating "On"
Green LED for alarm 1: process value within limits
Red LED for heating current: limit value exceeded

Input circuit monitoring (in upper display)
"FbF" = sensor break
"POL" = reversed polarity
"SSr" = short-circuited SSR

ENVIRONMENTAL CONDITIONS

Permissible temperatures

Operation with 50 % duty cycle:
0...50°C
Operation with 100 % duty cycle:
0...40°C
Storage/transport: -20...60°C

Climatic category KUF to DIN 40 040
Relative humidity: ≤75% yearly average, no condensation

GENERAL

Housing

19-inch tabletop housing.
For dimensions, see Table 1.

Protection mode

(to IEC 529, DIN 40 050)
Housing: IP 20
Electrical connectors: IP 54 when inserted and locked

Electrical safety

Tested to IEC 348 (VDE 0411)

CE-marking

According to European Directive 93/44/EEC for electromagnetic compatibility (unrestricted use within rural and industrial areas).

Electrical connections

Sensors and heating current
Heavy-duty multi-pole connectors

Alarm outputs and input for set-point lowering Via 7-pin connectors

Weight: see Table 1

Accessories
4m cable for mains connection
User manual

Table 1

| Number of control loops | Max. load per phase | Housing size (W x H x D) | Weight (approx. kg) |
|-------------------------|---------------------|--------------------------|---------------------|
| 1 | 16A / 3,3 KW | 330 x 164 x 400 | 5 |
| 2 | 16A / 3,3KW | 330 x 164 x 400 | 5,5 |
| 4 | 25A / 4,1 KW | 534 x 164 x 400 | 12 |
| 6 | 25A / 4,1 KW | 534 x 164 x 400 | 15 |
| 8 | 25A / 4,1 KW | 534 x 164 x 400 | 18 |
| 10 | 40A / 9 KW | 534 x 297 x 400 | 27 |
| 12 | 40A / 9 KW | 534 x 297 x 400 | 28 |
| 14 | 40A / 9 KW | 534 x 297 x 400 | 30 |
| 16 | 40A / 9 KW | 534 x 297 x 400 | 31 |
| 18 | 63A / 12 KW | 534 x 431 x 400 | 40 |
| 20 | 63A / 12 KW | 534 x 431 x 400 | 42 |
| 22 | 63A / 12 KW | 534 x 431 x 400 | 44 |

ORDERING DATA

| Number of control loops | Order number | Accessories | Order number |
|-------------------------|-----------------------|--|-----------------------|
| 01 | 9407 415 10011 | Connecting cable for sensor input & power output, length 4m, connector 6-pin standard | 9407 415 90111 |
| 02 | 9407 415 10021 | | |
| 04 | 9407 415 10041 | Connecting cable for sensor input, length 4m, connector 16-pin standard 1 | 9407 415 90121 |
| 06 | 9407 415 10061 | | |
| 08 | 9407 415 10081 | Connecting cable for power output, length 4m, connector 16-pin standard 1 | 9407 415 90221 |
| 10 | 9407 415 10101 | | |
| 12 | 9407 415 10121 | Connecting cable for sensor input & power output, length 4m, connector 16-pin standard 2 | 9407 415 90321 |
| 14 | 9407 415 10141 | Connecting cable for sensor input, length 4m, connector 24-pin standard 1 | 9407 415 90131 |
| 16 | 9407 415 10161 | | |
| 18 | 9407 415 10181 | Connecting cable for power output, length 4m, connector 24-pin standard 1 | 9407 415 90231 |
| 20 | 9407 415 10201 | | |
| 22 | 9407 415 10221 | Connecting cable for sensor input & power output, length 4m, connector 24-pin standard 2 | 9407 415 90331 |
| 24 | 9407 415 10241 | | |
| | | 1 set of connectors for alarms / set-point lowering / boost | 9407 415 90001 |
| Spare parts | | | |
| | | Super-fast cartridge fuse, 16 A, Qty. 10 | 9404 415 11101 |
| | | Solid-state relay, 45 A, Qty. 1 | 9407 509 00321 |
| | | Temperature controller HRC 50 | 9404 407 72052 |

**PMA**

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