

User Manual For HRS-Series of Hot Runner Controllers



DMS Ltd,
Unit 11, Blenheim Road,
Cressex Industrial Estate, High
Wycombe, Bucks, HP12 3RS

Tel: +44 (0)1494 523811
Fax: +44 (0)1494 452898

HRS Users Manual
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This manual is intended for use with the HRS Series controller
(Serial No.....) with which it was supplied.

Our policy is one of continuous improvement and we reserve the right to alter product specifications at any time without giving notice.

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Specification

The following are general specifications. The actual controller/console supplied may have contractual variations and differ in some specified options.

Supply Voltage: HRS	Single phase with 13A or 16A connector Plug
Supply Voltage: HRS4HP	415v 3 phase 50/60Hz with neutral, others available 240/480v Star/Delta
Supply Voltage Tolerance:	± 20% supply voltage swing.
Supply Protection:	Miniature Circuit Breaker
Overload Protection:	High Speed Semiconductor Fuse Links
Mains Voltage Output:	Burst fired, zero crossover.
Output Current: HRS	10 A max
Output Current: HRS4HP	15 A max
Control range:	0 - 472 Centigrade (Celsius).
Temperature scale:	Centigrade (Celsius).
Control Method:	Open or closed loop with HR software.
Thermocouple input:	Iron Constantan Fe/Con type 'J',
Front panel LED Indicators	Normal running, high and low temperature Alarm
T/C & Heater Tool connector	Harting type Han A or equivalent.
Keypad	7 pad, tactile switch
Display	4 x 20 characters, LCD
Case: HRS	Metal case 44w x 10h x 20d cm
Case: HRS4HP	Metal case 36w x 16h x 34d cm

Introduction

Safety Instructions



DO NOT enter the cabinet without first ISOLATING the supplies –there are unguarded terminals inside the cabinet which may have a dangerous potential across them.

Where a three-phase supply is used then this potential may be at 415 volts or higher.

Safety Notices - an explanation

Within this manual, safety instructions are marked as follows:



A WARNING symbol and message, shown here, identifies where there may be a hazardous situation which, if not avoided, may result in death or injury to personnel.

Most warnings pertain to electrical aspects and you must comply with them to minimise any personal danger.

CAUTION

A CAUTION warning identifies where there may be a hazardous situation which, if not avoided, may result in damage to property.

Caution warnings present no personal danger, but may cause the equipment to fail or lose its memory.

Welcome

DMS welcomes you to their HRS range of temperature controllers for hot runner injection moulding tools. This particular member of the proven family of DMS Hot Runner Controllers, is user friendly and retains the standard control facilities associated with other DMS controllers.

How to use this manual

The purpose of this manual is to give you a complete understanding of how best to use the controller and to assist where there are problems or faults.

The first part of this manual (from here to page 12) contains a brief technical description of the system components and a portrayal of the DMS operating philosophy that facilitates precision temperature control.

The following chapters then take you carefully through the stages of setting up, and running, a new control system. After considering system maintenance the final sections look at trouble shooting to assist in the unlikely occurrence of a system fault.

Where to use this equipment

DMS Hot Runner temperature controllers are designed for use in the plastic injection moulding industry as temperature controllers for third party hot runner systems as commonly used in mould tools. The controllers must not be used in residential, commercial or light-industrial environments. Furthermore, they must not be used in an explosive atmosphere or where there is a possibility of such an atmosphere developing.

They should be installed in a clean dry environment where the ambient conditions do not exceed the following limits: -

- Temperature 0 to +35°C.
- Relative Humidity 90% (non-condensing)

When in use this equipment does not emit audible noise in excess of 10dbA.

Controller – Tool Connections

The various connections to the system using the cables supplied with the equipment are specified in the loom or cable data sheet and Appendix A.

Equipment failure through mis-wiring

Before you energise the system, pay special attention to how the supply to your controller is wired and how it is connected to the mold.

Lack of attention to detail causes errors such as:

- incorrect wiring of mains supply phases into the controller
- crossing heater supply feeds with thermocouple detection (although this error can be eliminated by the adoption of DMS Standard connections)

In such cases wiring errors have caused equipment failure.

DMS cannot be responsible for damage caused to the controller by customer wiring and/or connection errors.

Controller Power Supplies

The control cabinet can be manufactured to accept a wide range of supplies and sequence of phases. Refer to the serial plate in the controller cabinet for confirmation of the supply requirements. If the local supply is outside the specified range please contact DMS for advice.

Tel: +(0) 44 494 523811

Fax.: +(0)44 1494 452898.

The Controller Cabinet

The HRS is a two-part case with the input and output cables rear mounted along with the main switch. Load fuses are panel-mounted on all models so that changing a fuse does not require operator access to the inside of the case. There are no user serviceable parts inside the case

Controller Cards

There are two boards mounted inside the HRS cabinet. The main motherboard, which controls the zone temperatures, and the display board for the visual display and interface processing. The motherboard card has three main components:

- thermocouple amplifier,
- CPU,
- multi-voltage output triacs.

Thermocouple Amplifiers

HRS Controllers are normally configured for use with J-type thermocouples.

Central Processor Unit (CPU)

The CPU provides the following facilities: -

- closed and open loop control of the zones,
- communicates settings and thermocouple readings over the data link to the display micro-processor
- checks for alarm conditions, including blown fuse, incorrect thermocouple wiring, zone over temperature condition, heater not responding to controller output and generates alarm information for the display screen and alarm relay (if fitted),
- controls the output power to both the on-board and off-board triacs using a number of self-tuning algorithms,
- monitors the thermocouple every 20 milliseconds
- continuous monitoring of a reference voltage signal on the bus and adjusts the on-board triac output to compensate for fluctuations in the supply voltage. the system can accommodate up to 30% swings in the supply

The card requires no analogue calibration and is ready for use once set up from the display console.

Display Board

The display board drives the LCD display unit and communicates input from the tactile keypad to the central processor via a data link.

Input and Output Supplies

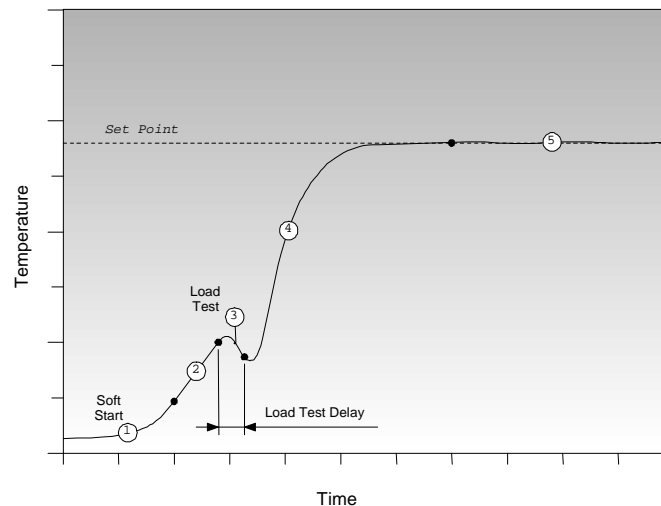
The power supply to the cabinet is via a cable at the rear of the panel that may be single or 3-phase according to particular model and load requirements.

Connections to the tool are made through a single loom which carries the heater supplies and thermocouple returns. End terminations are made through a Harting type Han A female connectors or their equivalents and the wiring details are shown in Appendix A.

How the DMS Controller Works

DMS controllers are designed to perform in closed and open loop configurations. However, we consider that the normal operating mode is closed loop.

Whenever the controller is set to start, the system goes into a self-calibration routine. This is illustrated in the following diagram and explained below.



- The zone controller slowly ramps up the heater power and simultaneously looks for a positive temperature change at the thermocouple input. The controller verifies the actual rate of rise against a predetermined value. Power is slowly increased until the correct rate of rise is achieved.
- The controller now increases the zone temperature at a constant rate of rise until the temperature reaches about 110°C (230°F).
- At 110°C the controller performs a 'Load Test' on the zone heater to check its thermal characteristics. The output power is reduced to zero for a test period and the temperature monitored for a response. From all this information, the controller has built mathematical model of the heater characteristics and so it can automatically select a Fast, Medium or Slow response heating program that suits the tool. This allows more efficient control of the zones.
- The controller continues to ramp up the temperature to the set point, which should be achieved with minimum over-shoot.
- Having built a virtual model to map the tool and heater characteristics, the controller can maintain the temperature at an accurate point with virtually no deviation.

Watchdog feature

The Controller card CPU has a 'watchdog' timer that has to be reset by the system every 3 milli-seconds. If for any reason the software fails to reset the timer, the program is reset to the start position, which initialises the controller so protecting the tool against over-heating. The card resumes control of the zone from the start position.

Safety Memory Check

This controller uses RAM, with a battery back-up, to store all your settings such as temperatures, limits and alarms. There is an extremely low small risk that an interruption may cause any of these settings to alter and, if such an event should occur, then there must be no risk to the equipment. If a zone that had previously been set to, say 260 deg, should become corrupted to, perhaps 520 deg, then the controller must not attempt to establish the incorrect temperature upon the next start-up command.

To ensure that this cannot happen there is a safety memory-check facility. This checks to see that no value has been changed since the last time that the controller was used. If this facility detects that **any** setting is different, then it protects your system by automatically erasing **every single** stored setting within its memory. If such a rare occurrence happens to your controller then you will be met by the following screen message when you switch on:

"CAUTION SYSTEM RAM ERROR
Stored values HAVE been ERASED"

If you read this then you will need to go through all the various screens and input all appropriate settings. This basic task is described in the next chapter of this manual. The task is easier if you have all the correct settings written down in a safe place.

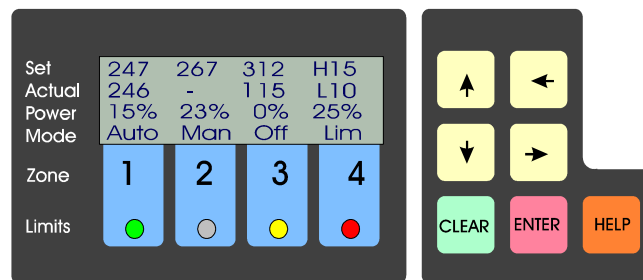
CAUTION

DMS recommends that a hard copy of all the controller and tool settings are saved in a safe place.

The HRS Console

Screen

The 4 x 20 LCD Screen displays all the necessary information on one screen. The information is divided into four rows to show “Set” temperature, “Actual” temperature, “Power” level and Operating Mode. This last row is also used to display setting-up information and error messages.



The screen contrast may be adjusted using a small flat-blade screwdriver inserted through an aperture just above the [↑] arrow. This gives access to a trim-pot which may be turned to alter the screen appearance.

Keypad

The standard keypad has 7 keys including 4 arrow keys (up, down, left and right), an ENTER key, a cancel or CLEAR key and a HELP key.

Arrow Keys: These are used to move about the display and select features.

Enter Key: This key enters the command selected on the screen. E.g. to enter a value or select a menu option.

Clear Key: If an entry is started the clear key erases the whole of the entry.

Help Key: This displays the built in help menu which can give assistance.

Front panel Status Indication

There are LED indicators below each channel to show its status:

- Green The controller is operating normally.
- Amber The actual temperature of the particular zone is below the lower limit of the set point.
- Red The actual temperature of the particular zone is above the lower limit of the set point.

Using your controller

The HRS is a simple and accurate multi-channel Hot Runner Controller which can easily be adapted to accommodate many different working environments. Its accuracy is derived from the CPU temperature control described earlier, while its simplicity comes from the single page display with its touch pad control.

What is covered in this section

Switching On and Off

Setting the required temperatures

Setting zone power levels

Changing Speed settings

Setting Zone Limits

Switching Zones off

Help Feature

Switching On and Off

For the HRS models, the main Power Switch is a rocker Switch at the rear of the cabinet. For the HP variation it is a three-pole rotary switch. Both switch types are sufficiently rated to disconnect the total load current and these are used for switching “On” and “Off”

“0 ° C/F” or “0% Power” is NOT Switched Off



The heat of a nozzle is proportional to the applied current. Setting any zone to zero degrees temperature, or 0% power, means that only the current is reduced to zero. However, the current-control is not a breaking-contact switch but a semi-conductor device known as a Triac. This means that, at zero current, there may still be some voltage at the nozzles.

On a single phase, or 3-phase “star” supply with a neutral, the triac is on the live side of the supply – this keeps residual voltage to a low value. However, on a 3-phase delta wired supply there will be phase voltage on the nozzle while the controller’s main isolator is On, even when the heating is set to zero degrees, 0% or “Off”.

ALWAYS isolate the controller before you open up a controller to examine any wiring or change fuses. Remember that, with respect to the mains supply, “0% power is NOT “Off”.

Setting the zone temperatures

Where you wish to set a fixed temperature — using Closed Loop mode — the controller will hold the required output to maintain that temperature.

1. Use the Left and Right arrow keys to select the particular zone. Use the Up [↑] and Down [↓] keys to display **AUTO** in the upper “Mode” Row and press [Enter]. The Cursor now highlights the top “Set” row.
2. Set the temperature point by using the [↑] or [↓] arrows to increase or decrease the temperature. Each depress alters the current value by one and while in the mode you can also use the [←] and [→] arrows to shift the cursor up and down the units from tens to hundreds and back again. This makes it easier for you to make large changes.
3. When the set value is correct press the [Enter] button to confirm the new settings and the cursor moves back to the “Mode” row leaving the new Set temperature as you require.

Setting Zone power levels (manual working)

Where you wish to set fixed power settings — using Open Loop mode — the controller will hold the power output to your set level.

1. Use the Left [←] and Right [→] arrow keys to select the particular zone, then use the Up [↑] and Down [↓] keys to display MAN in the “Mode” Row and press [Enter]. The Cursor now highlights the third “Power” row.
 2. Next, set the power level by using the [↑] or [↓] arrows to increase or decrease the displayed power setting. Each depress alters the current value by one.
 3. When the set value is correct press the [Enter] button to conform the new settings and the cursor moves back to the “Mode” row leaving the new power output as you require.
-

Changing Speed settings

On page 11 we described how the DMS controller can automatically select the correct operating speed for you particular load. However, you can override this automatic selection and force the controller into one of three preferred modes.

1. Use the Left[←] and Right[→] arrow keys to select the particular zone, then use the Up[↑] and Down[↓] keys to display the Speed settings in the “Mode” Row and press [Enter] when your preferred speed is displayed. The options are:
 - Fast** — This settings tends to be preferred where probes and Heaters have integral thermocouples
 - Medi(um)** — Use this setting for medium reaction time heater loads such as large probes or, more often, small sub-blocks.
 - Slow** — this is only required for larger heaters with slow reaction times such as manifolds or platens with a large heating mass.

Setting Zone-Alarm limits

You can set zone limits to provide a visual warning if actual temperatures go above or below the nominal set points. They may be independently set within the range of 1 to 99 ° C.

To set these limits:

1. Use the Left[←] and Right[→] arrow keys to select the particular zone. Use the Up[↑] and Down[↓] arrow keys to display **LIM** in the lower “Mode” row and press [Enter].
2. The cursor moves to the top row where the letter **H** is displayed alongside the present high alarm point. Use the Up[↑] and Down[↓] arrow keys to set the alarm point and press [Enter] when it is correct.
3. The cursor now moves to the second row where the letter **L** is displayed alongside the present low alarm point. Use the Up[↑] and Down[↓] arrow keys to set the alarm point and press [Enter] when it is correct.
4. The display now returns to its previous working mode and shows Man or Auto accordingly.

Turning a zone off

Any single zone can be individually switched off while leaving the other working zones unaffected.

1. Use the Left[←] and Right[→] arrow keys to select the particular zone, and then use the Up[↑] and Down[↓] arrow keys to display **OFF** in the mode Row and press [**Enter**].
2. The message “OFF” will then be displayed within the Mode window.

All the power settings remain unchanged while the Zone is switched off.

To restore that zone use the keys to select “Auto” or “Man”.

Using On-Screen Help

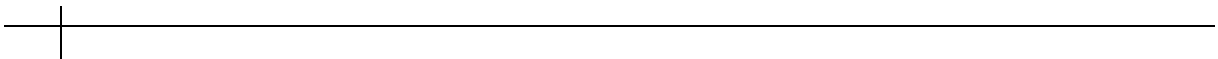
The HRS Controller has an On-screen help section which may be accessed while the controller is running.

To use this facility simply press the [Help} button on the keypad to display a list of Help topics.

1. Auto
2. Man(ual)
3. Limits
4. Off
5. Keys
6. Faults

Use the Up[↑] and Down[↓] arrow keys to step the cursor through the options and press [**Enter**] when you are at the required topic.

Each page of Help text is self contained and self explanatory. To return to normal operation press the [**Clear**] key and you will return to the front display with everything set as before using the Help facility.



Troubleshooting

Error Messages

The control system has several features, which provide an early diagnosis of faults in the control system, the tool heaters and thermocouple sensors.

If the system detects any malfunctions, in one or more of the control zones, then it may display any of four error messages in “Mode” row.

Error Message	Cause	Action
ERR!	No temperature rise has been detected in that zone.	Check thermocouple wiring, it may be reversed. Heater wiring may be faulty or element may be open circuit.
FUSE	The fuse for that zone has failed. Please Note: A fuse can only fail due to a fault external to the controller. Identify and rectify the fault before replacing the fuse.	Replace the fuse with one of the same rating and type, i.e. High Rupture Current load fuse. The fuses are panel mounted on the back of the unit.
OVER	The particular Zone temperature is exceeding the limits	There could be an interaction between the zones or the wrong thermocouple may be connected to the zone input. Check the thermocouple wiring.
T/C	An open circuit thermocouple has been detected.	Check the thermocouple wiring for a loose connection. If OK then replace the thermocouple as soon as convenient.

Specific Faults

Rapid Temperature Fluctuations:

The most likely cause of temperature fluctuations is extraneous voltages being picked up by the thermocouple cable, i.e. common mode. This may be due to poor earthing of the tool or, alternatively, a faulty heater. We recommend that all earth connections are tested.

Servicing and repairing

**WARNING**

Always isolate your controller at source before you replace fuses or open the unit for inspection.

When it comes to machine maintenance there is very little that you need to do to look after it.

Replacement parts

DMS does not expect that you will need to repair any controller parts at board level other than fuses. In the unlikely event of any board failure then we provide an excellent repair and exchange facility for all our customers.

Regular Inspection

The aperture for the rear-mounted fan should be checked, periodically, to see that it has not become clogged and that the fan is free to rotate. Failure to do this can allow lint and dust to collect and reduce the flow of cooling air. This, in turn, may incur more expensive repairs if internal components subsequently overheat.

External cable-looms should be checked to see that there has been no damage to the flexible conduit, plugs or sockets. If the flex has been squashed, if there is visible damage, or if there are any exposed conductors, then, for your own safety, it must be replaced.

APPENDIX A
HRC Wiring Standards

HRC Wiring Standards

The following standards only apply to HRS controllers wired to DMS standard. Other specifications may have been stated when the controller was ordered. Please refer to the supplied specification details.



1. CONNECTION INFORMATION

1.1 Mains supply cable termination



Please take extreme care when connecting the controller to the mains supply, especially if it is a three-phase supply. Incorrect connection may appear to work but can result in damage to the controller.

The controller is normally supplied with the mains supply cable suitably terminated into an appropriate plug. However, if the unit is requested without any mains plug then the conductors will be labelled as shown below.

Cable Marking	Single phase supply	3-phase star supply 	3 phase delta supply 
L1	Live	Phase 1	Phase 1
L2	<i>No Connection</i>	Phase 2	Phase 2
L3	<i>No Connection</i>	Phase 3	Phase 3
N	Neutral	Neutral	<i>No Connection</i>
Earth Symbol	Earth	Earth	Earth

N.B. The delta supply cable does not have a neutral wire.

Cable colours may vary therefore wire up according to the Cable Markings.

1.2 Loom Thermocouple cables

Thermocouple cable colours and number may vary. Refer to controller documentation for details.

Normally J-Type are the only thermocouples catered for although K-type may be accommodated as a special.

Type	Positive	Negative
J	Black	White
K	Green	White

1.3 Loom Power cables

The colour of the power cables will depend on whether the controller is supplied for single phase or three phase star or delta supply.

Supply	Live (supply)	Neutral (return)
Single phase	Brown	Blue
3-phase star	Red	Blue
3-phase delta	Red	Yellow

2. LOOM TOOL END CONNECTIONS.

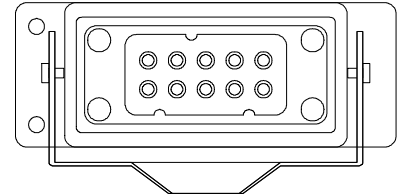
2.1 For HRS2 models:

Tool Connector

Harting Han 10A

1 off male insert 09 20 010 2612

1 off housing 09 20 010 0301



Connections

Pin	Zone	Connection
1	1	T/C Positive
2	1	T/C Negative
3	1	Supply
4	1	Return
5		N/U
6	2	T/C Positive
7	2	T/C Negative
8	2	Supply
9	2	Return
10		N/U

N/U = Not used

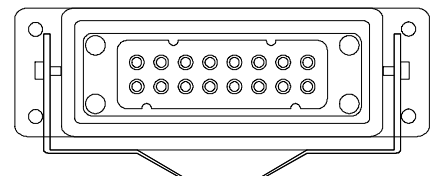
2.2 For HRS4 (HP) models

Tool Connector

Harting Han 16A (16E for HP version)

1 off male insert 09 20 016 2612

1 off housing 09 20 016 0301



Connections

Pin	Zone	Connection	Pin	Zone	Connection
1	1	T/C Positive	9	3	T/C Positive
2	1	T/C Negative	10	3	T/C Negative
3	1	Supply	11	3	Supply
4	1	Return	12	3	Return
5	2	T/C Positive	13	4	T/C Positive
6	2	T/C Negative	14	4	T/C Negative
7	2	Supply	15	4	Supply
8	2	Return	16	4	Return

2.3 For HRS8 models

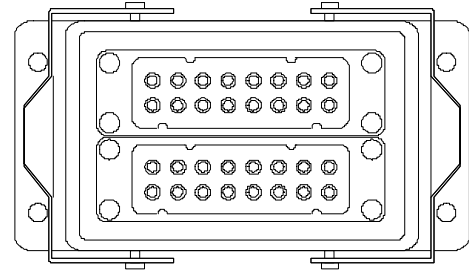
Tool Connector

Harting Han 32A

1 off male insert 09 20 016 2612

1 off male insert 09 20 016 2613

1 off housing 09 20 032 0301



Connections

Pin	Zone	Connection	Pin	Zone	Connection
1	1	T/C Positive	17	5	T/C Positive
2	1	T/C Negative	18	5	T/C Negative
3	1	Supply	19	5	Supply
4	1	Return	20	5	Return
5	2	T/C Positive	21	6	T/C Positive
6	2	T/C Negative	22	6	T/C Negative
7	2	Supply	23	6	Supply
8	2	Return	24	6	Return
9	3	T/C Positive	25	7	T/C Positive
10	3	T/C Negative	26	7	T/C Negative
11	3	Supply	27	7	Supply
12	3	Return	28	7	Return
13	4	T/C Positive	29	8	T/C Positive
14	4	T/C Negative	30	8	T/C Negative
15	4	Supply	31	8	Supply
16	4	Return	32	8	Return

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