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User Manual

Dryer Controller M720

Hardware version 1.00
Software version 1.00

Preliminary version

Document history

Preliminary version:

- Created in April, 2009

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1) General description of the controller

The M720 is a user configurable microprocessor controller used to control drying machines. Because of the versatility of the software, it can be used in almost any type of dryer, without the need to modify the software.

The controller has the following features:

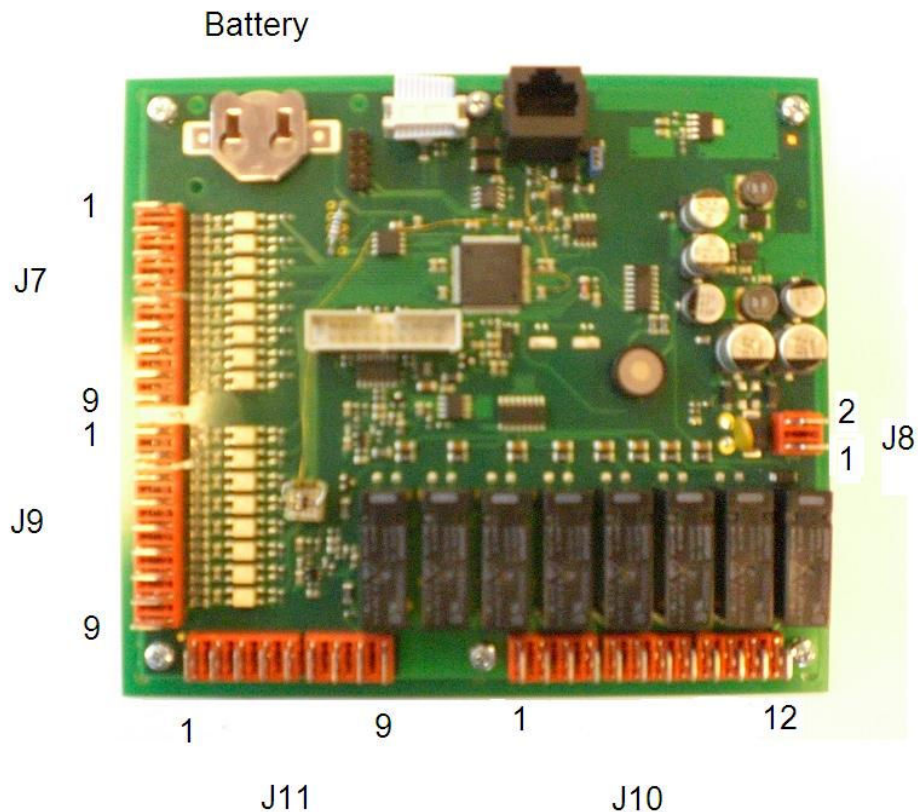
- 192 x 32 pixels display, fully graphically controlled.
- 3 large 7-segment displays to indicate estimated time left and alarms.
- 20 buttons with "cap-sense" technology. These buttons work with capacitive measurement, without any moving parts so increasing reliability.
- 50 different drying programs, each with an own name of up to 32 characters to indicate the type of program.
- 16 digital optically isolated inputs, 24VAC or 24VDC.
- 8 digital relay outputs, up to 250VAC, 8A.
- 2 probes for temperature measurement.
- 1 analogue output for controlling the drum speed in cases where a frequency inverter is used.
- Up to 8 extension boards, each with 8 inputs and outputs can be used to extend the number of inputs and outputs if required.
- Power supply 24VAC or 24VDC.
- RS485 communication port for communication with PC for up- and downloading parameters, translations, character sets, etc.
- Power supply monitoring. In case the power supply drops below or rises above a certain limit, the controller will switch off all outputs and give an alarm message.
- Full worldwide character set, including Chinese, Japanese, Thai, Russian, Arabic and Greek characters.
- Possibility to store up to 50 different languages.
- No parameter settings will be lost in case of power supply failure or an empty battery.
- Self-configurable start-up logo, which can be used to customize the controller.
- Possibility to edit and add languages with the use of free software.
- Extended test programs which allow the user to monitor and control each input/output individually.
- Counters per program, total counters and counters per day. The production data of the last 50 days is stored.
- Alarm history which records the last 50 alarms and messages since the last start-up.

2) Connecting the controller and the extension boards

A dryer controller set always comprises a dryer controller CPU board, with inputs and outputs on board. Optionally, the controller can be expanded with extension boards to increase the number of available inputs and outputs. All print boards have to be connected to a power supply and to the inputs and outputs through the available connectors. This chapter describes the location and the purpose of each available connector on the print boards.

2.1) Dryer controller M720

The dryer controller is build up from 2 print boards, a processor board and a front-print board. The processor board has number M721A and the front-print board with the buttons and the displays, has number M721B. All the connections on the dryer controller are on the backside (on the processor board). The connectors are used for different purposes:



J7: Inputs 1 until 8

Pin 1:	Input 1
Pin 2:	Input 2
Pin 3:	Input 3
Pin 4:	Input 4
Pin 5:	Input 5
Pin 6:	Input 6
Pin 7:	Input 7
Pin 8:	Input 8
Pin 9:	Common for inputs 1 until 8 (0VDC or 24VAC neutral)

J8: Power supply (21-24 VAC/VDC)

Pin 1: 24VDC / 24VAC
Pin 2: 0VDC / 24VAC Neutral

J9: Inputs 9 until 16

Pin 1: Input 9
Pin 2: Input 10
Pin 3: Input 11
Pin 4: Input 12
Pin 5: Input 13
Pin 6: Input 14
Pin 7: Input 15
Pin 8: Input 16
Pin 9: Common for inputs 9 until 16 (0VDC or 24VAC neutral)

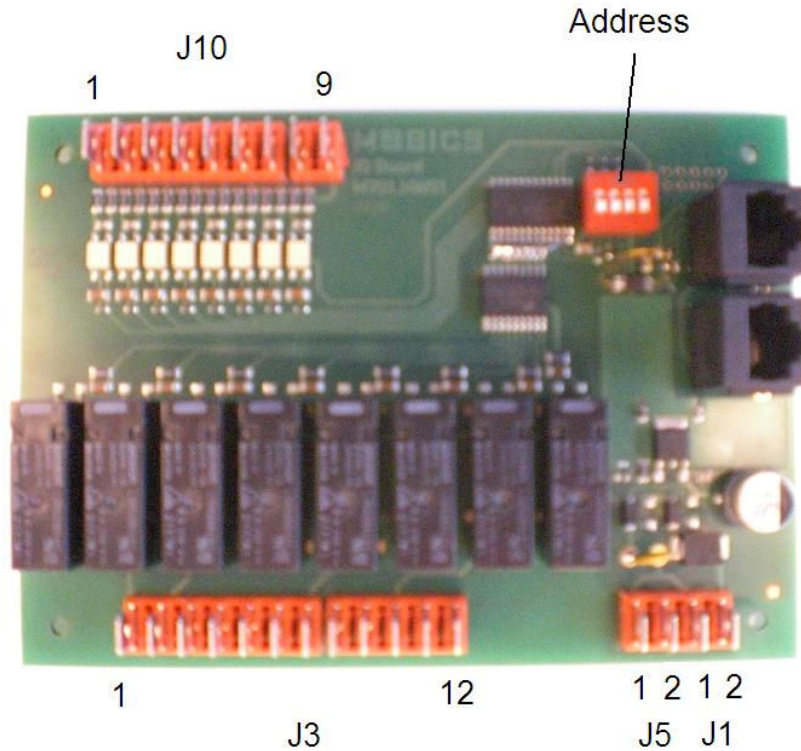
J10: Relay outputs 1 until 8

Pin 1: Common for output 1
Pin 2: Output 1
Pin 3: Output 2
Pin 4: Output 3
Pin 5: Output 4
Pin 6: Common for output 2, 3, 4, 7 and 8
Pin 7: Output 5
Pin 8: Common for output 5 and 6
Pin 9: Output 6
Pin 10: Output 7
Pin 11: Output 8, normally open contact
Pin 12: Output 8, normally closed contact

J11: Analogue I/O and digital output

Pin 1: NTC sensor 1, wire 1
Pin 2: NTC sensor 1, wire 2
Pin 3: NTC sensor 2, wire 1
Pin 4: NTC sensor 2, wire 2
Pin 5: Analogue out, ground
Pin 6: Analogue out, 0-10VDC
Pin 7: GND
Pin 8: +24VDC
Pin 9: Digital output 24VDC, not potential free, max. 20mA

2.2) Extension board type M701



J1: Power supply connection 1

Pin 1: 24VDC / 24VAC
Pin 2: 0VDC / 24VAC Neutral

J3: Relay outputs 1 until 8

Pin 1: Common for outputs 1, 2, 3 and 4
Pin 2: Common for outputs 1, 2, 3 and 4
Pin 3: Output 1
Pin 4: Output 2
Pin 5: Output 3
Pin 6: Output 4
Pin 7: Common for outputs 5 and 6
Pin 8: Output 5
Pin 9: Output 6
Pin 10: Common for outputs 7 and 8
Pin 11: Output 7
Pin 12: Output 8

J5: Power supply connection 2

Pin 1: 24VDC / 24VAC
Pin 2: 0VDC / 24VAC Neutral

J10: Inputs 1 until 8

Pin 1: Input 1
Pin 2: Input 2
Pin 3: Input 3
Pin 4: Input 4
Pin 5: Input 5
Pin 6: Input 6
Pin 7: Input 7
Pin 8: Input 8
Pin 9: Common for inputs 1 until 8 (0VDC or 24VAC neutral)

Address:

Every extension board connected to a controller must have a unique address. This address may vary between 1 and 8. The address can be set-up with the dipswitches on the extension board:

Switch 1	Switch 2	Switch 3	Switch 4	Address
OFF	OFF	OFF	OFF	1
ON	OFF	OFF	OFF	2
OFF	ON	OFF	OFF	3
ON	ON	OFF	OFF	4
OFF	OFF	ON	OFF	5
ON	OFF	ON	OFF	6
OFF	ON	ON	OFF	7
ON	ON	ON	OFF	8

2.3) I/O signals from and to the dryer

By default, the inputs and outputs on the dryer controller board have a fixed assignment. Depending on the type of the machine, the assignment of the inputs and outputs on the extension boards may vary. In this chapter the assignments and purpose of the inputs and outputs on the CPU board are described.

2.3.1) Input signals on the CPU board

As described in chapter 2.1, the dryer CPU board has 16 digital inputs available to connect signals needed to control the dryer.

In the input list below will be referred to message numbers when an input is not in the right state. The list of messages with corresponding numbers can be found in chapter 7.

Input 1: Door closed

This input should be 'on' when the door is closed. A program can only be started in case the door is closed. When a drying cycle or cool-down cycle is busy and the door is opened, the cycle will stop and message 13 will be displayed. If a cycle is finished after drying and cooling-down, and the door is opened, the controller will be ready for a new cycle.

Input 2: Filter door open

This input should be 'on' if the filter door or drawer is closed. If the filter door or drawer is opened, message 12 will be displayed. If the dryer was in a drying, cool-down or anti-crease cycle, this cycle will be stopped. After closing the filter door or drawer again, the cycle may be restarted with the start button on the panel.

Input 3: Air flow switch

To detect if the blower creates a sufficient air flow, an air flow switch is available. This air flow switch should be in the 'off' position when the dryer blower is off. When the blower starts, the air flow switch should go to the 'on' position after the blower has created sufficient air flow. At the moment the dryer is started, the control checks if the air flow switch is in the 'off' position. If not, message 14 will be displayed. After the blower has been started, the air flow switch must go to the 'on' position within an adjustable delay (machine parameter 33, see chapter 'Machine parameters'). If the air flow switch isn't in the on position in time, the dryer will be stopped again and message 14 will be displayed. Because of fan inertia, the air flow switch will not be in the 'off' position directly after the output for the blower is stopped. This means that if the stop button is pushed and the start button is pushed directly after that, message 14 can be displayed because the air flow switch hasn't reached the 'off' position yet.

Input 4: Input overload

This input should be used to connect all available motor overload protectors. The protectors should be connected in series, so that the input is 'on' when no overload protection is active. The controller continuously checks this input and if the input is 'off', message 2 is displayed.

Input 5: Input coin box 1.

Not implemented yet. Is reserved for future purposes to receive a signal that a coin of type 1 has been deposited.

Input 6: Input coin box 2

Not implemented yet. Is reserved for future purposes to receive a signal that a coin of type 2 has been deposited.

Input 7: Rotation sensor

This input is used to connect a drum rotation sensor. If the presence of a rotation sensor is configured (see chapter 'Configuration parameters', parameter number 17), the controller checks this input when the drum is running. This means that, if the drum is running, the rotation sensor input should go from the 'off' to the 'on' state on a regular basis. The maximum time it may take for the rotation sensor to be detected is adjustable with machine parameter 26 (see chapter 'Machine parameters'). If the drum speed is controlled by inverter and the analogue output of the controller, the time-out duration is

automatically compensated by the software. If the drum is running, and the rotation sensor hasn't been detected properly for too long, message 10 is displayed.

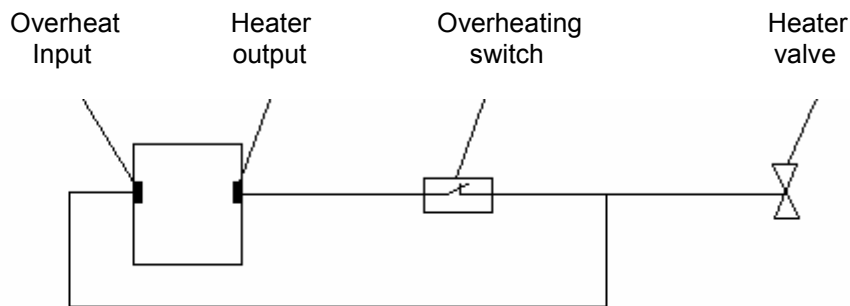
Please note that the rotation sensor can only be a sensor of the 24VDC type. If a 24VAC type is used, this will not work and rotation alarms will be displayed continuously.

Input 8: Air pressure switch

This input is used to connect an air pressure switch to detect if enough air pressure is available for the machine to be able to operate. The controller will continuously check input 8. If enough air pressure is present, the input should be 'on'. If the input is in the 'off' state, this means not enough air pressure is present and the machine is not allowed to run. In this case, message 11 is displayed. If no air pressure switch is connected, this input should be connected to 24V, so it is always in the 'on' state.

Input 9: Overheating input

This input is used to connect an overheating switch. Usually, the overheating switch is wired into the output circuit which goes to the heater. This is done for safety, so the heater can never be on in case the overheating switch is active. If the overheating switch is connected to input 9 as well, the heater output is fed back to the overheating input through the overheating switch, which can be seen in the wiring example below.



If no overheat input is connected, this input should be connected to 24V, so it is always in the 'on' state.

Input 10: Emergency stop and safety switches

If an emergency stop switch and other safety switches are separately connected to the controller, input 10 should be used for this purpose. The controller will continuously check input 10 and if the input is in the 'off' state, message 1 will be displayed. If the emergency stop switch and other safety switches are not separately connected, this input should be connected to 24V, so it is always in the 'on' state.

Input 11: Error frequency inverter

This input is used in case the drum motor is controlled by a frequency inverter (see chapter 'Configuration parameters', parameter number 8). The controller will start to check the input about 3 seconds after the drum motor is started. If the drum motor has been running for 3 seconds, and this input is in the 'off' state, message 3 will be displayed. If the inverter error contact is not used, this input should be connected to 24V, so it is always in the 'on' state.

Input 12: Jog left button

This input is used to connect a jog button. Use configuration parameter 20 to indicate the presence of jog buttons. Jogging of the drum can be done in case the machine isn't running, the door is closed and the emergency stop isn't active. When input 12 is in the 'on' state, the output for drum left direction will be activated.

Input 13: Jog right button

See input 12, but then for jogging in the right direction.

Input 14: Gas alarm input

If the machine is equipped with gas heating, this input can be used to connect the alarm contact of the gas heater. The input is checked continuously and if the input is in the 'on' state, the dryer is stopped and message 6 is displayed. If the gas alarm input is not used, this input should not be connected, so it is always in the 'off' state.

Input 15: Input fire suppression

This input can be used to connect a fire suppression contact. The controller continuously checks this input and if the input is in the 'off' state, the dryer is stopped and message 7 is displayed. If the fire suppression input is not used, this input has to be connected to 24V, so it is always in the 'on' state.

Input 16: Clean filter warning

This input can be used to connect a sail switch, which can detect if the filter has to be cleaned. The input will be checked when the heater and the blower motor are on. If both outputs are on, no overheating is active and input 16 is in the 'on' state for 2 seconds, the message 'Clean lint filter' will be displayed. If this input isn't used, then it doesn't have to be connected.

2.3.2) Output signals on the CPU board

As described in chapter 2.1, the dryer CPU board has 8 digital relay outputs available to connect signals needed to control the dryer.

Output 1: Heater unit reset

This output can be used to connect a signal to reset the heater installation. Every time a new drying program is started, this output will be activated for the time adjusted in machine parameter 30 (see chapter 'Machine parameters').

Output 2: Status output

This output is used to indicate the current status of the machine. How the output is controlled, is adjustable with configuration parameter 12 (see chapter 'Configuration parameters'). It can be used to indicate a drying cycle is busy, to indicate a cycle has been finished or to indicate an alarm is active. A combination of these states is also possible.

Output 3: Blower cleaning signal

This output is activated every time the start button is pushed. If the start button is pushed, the output is activated for the time adjusted in machine parameter 31 (see chapter 'Machine parameters'). Usually, this output is connected to an air-blast signal to clean the blower.

Output 4: Blower WYE switch

In large machines (with large blower motors) a WYE switch may be used to decrease the start-up current used by the blower motor. When the blower motor has to start up, this output will be activated for the time adjusted in machine parameter 32 (see chapter 'Machine parameters'). So, use this output to switch the star/delta switch.

Output 5: Drum motor direction left

If the dryer has a reversible drum, this is the output for letting the drum run in the left direction. If the dryer drum has only one direction, this is also the output for letting the drum run, although the motor can also be connected together with the blower to output 6 in this case. The presence (or absence) of a reversible drum can be indicated with configuration parameter 7 (see chapter 'Configuration parameters').

Output 6: Drum motor direction right

If the dryer has a reversible drum, this is the output for letting the drum run in the right direction. The presence of a reversible drum can be indicated with configuration parameter 7 (see chapter 'Configuration parameters').

Output 7: Blower

The output of the blower motor, This output will be continuously on when a drying or cool-down cycle is busy and the dryer is running. This output can also be used to connect the drum movement in case the drum isn't reversible.

Output 8: Heating

The output for heating. If the machine is running, a temperature control function will decide if heating is necessary, depending on the adjusted goal temperature and the current temperature(s). If heating is necessary, the output will be on, otherwise it will be off.

2.4) Replacing the battery

In chapter 2.1, a picture can be seen where the location of the battery is indicated. The battery is a CR2016 type, 3 Volt. Replacing the battery should be done with the power switched on. If power is switched off and the battery is taken out, all battery backed-up memory will be lost.

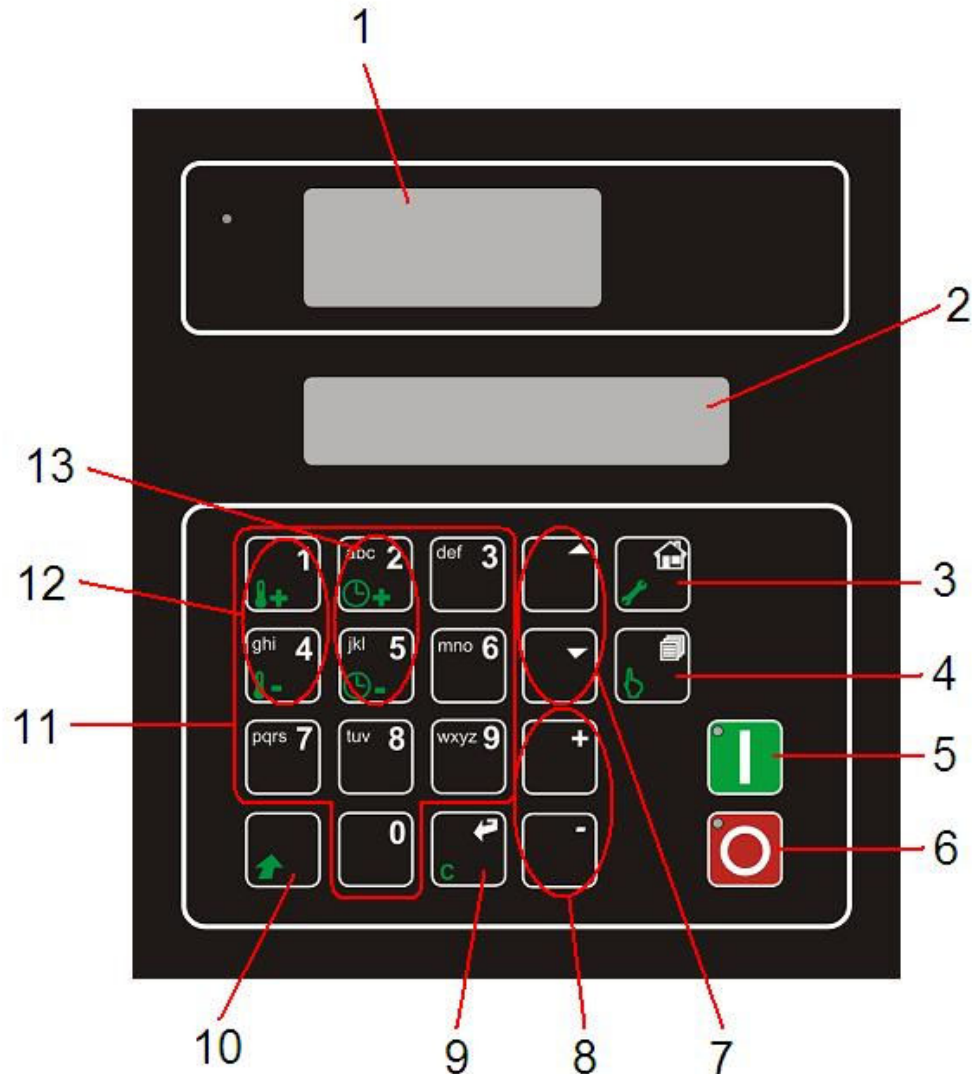
The battery capacity is enough to retain all data for 1 year. Replacing the battery should be done every year. If the battery has been empty, the controller will show alarm 19 when starting up (see also chapter 7). This means that if alarm 19 is shown on the display, the battery is empty already.

If the battery is empty, the following data will be lost:

- Counters per program (chapter 6.3.1)
- Counters per day (chapter 6.3.2)
- Counters in total (chapter 6.3.3)
- Time and date (chapter 6.6.1). Setting of time and date is especially important for the counters per day (chapter 6.3.2) and the alarm history (chapter 6.7).
- Last used program. After starting up with an empty battery, the controller will always start up in program 1.
- Cycle step. If the machine was running in a drying cycle or cool-down cycle, and the controller is switched off, the controller will start up again at the same moment in the cycle. This cannot be done anymore in case the battery is empty and the controller will start up at the beginning of a new cycle.
- Delayed start. If a delayed start was adjusted, and the controller has been switched off, the time until the delayed start is stored. Delayed start will be lost when the battery is empty.

3) Display and buttons on the controller

The layout of the control panel is:



In the picture above, buttons, button groups and the displays are indicated with a number. The following list describes the function of the displays and buttons.















1) Numeric display

A large display which can be read from longer distance. Is used to display current alarm number and estimated cycle time remaining. See chapter 4.3.




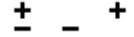

2) Graphical display

The display which is used to display detailed messages, displaying parameter values, counters, etc.

3.1) Buttons

	Item number in picture	Normal function	Shift function
	5	Start	-
	6	Stop	-
	10	Shift	-
	9	Enter	Clear
	4	Select program	Single cycle
	3	Home	Setup
	7	Arrow up (move to previous item)	Move to first item in parameter list
	7	Arrow down (move to next item)	Move to last item in parameter list
	8	Plus (increase single step)	Plus (increase multiple steps)
	8	Minus (decrease single step)	Minus (decrease multiple steps)
	12	Number one / alphanumeric special chars	Increase temperature set-point
	12	Number four / alphanumeric	Decrease temperature set-point
	13	Number two / alphanumeric	Increase cycle time
	13	Number five / alphanumeric	Decrease cycle time

3.2) Display symbols

Icon	Description
	Temperature symbol
	Dry time and cool down time
	Arrow keys limitation
	Plus and minus keys limitations
	Key pad icons.

3) Home- and setup-button

This button can be used in any screen to return to the overview screen. In case the overview screen is active and this button is pushed in combination with the SHIFT button (see item 10), the main menu is activated. The main menu gives access to controller functions like reading and resetting counters, adjusting parameters and doing test programs. See chapter 6 for an explanation of the possibilities in the main menu.

4) Select program button

If this button is pushed in the main screen, another drying program can be selected (see chapter 5.1.1). In case the overview screen is active and this button is pushed in combination with the SHIFT button (see item 10), a single cycle program can be entered (see chapter 5.1.2)

Note:

A pre-defined drying program or a single cycle program can only be chosen if there is no active drying cycle, a cool-down cycle or when a program is finished but there is still a batch inside the machine. In practice this means that this button only works if the machine is in the 'ready to start' state.

5) Start button




This button is used to (re)start the machine and to reset alarm messages. In case an alarm is active, and the cause of the alarm has been solved, the alarm can be reset by pushing this button. To start the machine after selecting a program (see chapter 5.2) or to restart the machine after a temporary stop (see chapter 5.3), this button also has to be used.

6) Stop button

This button is used to stop a program cycle. In case the machine is running a cycle, and this button is pushed once, the dryer will stop and the message 'Waiting for cycle restart' will be displayed. If the start button is pushed in this situation (see item 5), the cycle will restart. If the stop button is pushed once again, the current program cycle will be interrupted and the machine will go back to the 'ready to start' situation again and a complete new program cycle can be started.




The stop button is also used to silence the beeper in case of an alarm. At the moment an alarm is activated, the beeper will start beeping every second. To silence the beeper while working on the machine to solve the cause of the alarm, push the stop button once.

7) Arrow buttons

These buttons can be used to scroll through a list of, for example, menu-items. If the buttons can be used in a screen, this will be indicated with an icon. If a list is in the screen, and it's possible to both move up and down in the list, the  icon will be displayed. If it is only possible to use the down button (for example, when the current item is the first item in the list), the  icon will be displayed. If it is only possible to use the up button (for example, when the current item is the last item in the list), the  icon will be displayed.

In many cases these buttons can also be used in combination with the SHIFT button (see item 10). If the arrow buttons are used in combination with this button, the item will move to the first or last item instead of moving to the next or previous item.

8) Plus and minus buttons

These buttons can be used to increase or decrease an adjustable value, like a parameter. If the buttons can be used in a screen, this will be indicated with an icon. If a value is in the screen, and it's possible to use both the plus and minus buttons, the  icon will be displayed. If it is only possible to use the plus button (for example when a value has reached the maximum allowed limit), the  icon will be displayed. If it is only possible to use the minus button (for example when a value has reached the minimum allowed limit), the  icon will be displayed.

In many cases these buttons can also be used in combination with the SHIFT button (see item 10). If the plus and minus buttons are used in combination with this button, a value will increase or decrease with a higher value instead of 1.

9) Enter and clear button

Pushing this button without the SHIFT button (see item 10) means 'Enter'. If the button is pushed in combination with the SHIFT button (see item 10), it has a 'Clear' function.

The enter button is used to confirm a choice or an adjustment. For example, if another program is selected from the list, the enter button must be pushed to confirm the choice. This is the same in case a parameter value is adjusted. When a new value is entered, this value has to be confirmed with the enter button, otherwise the change in value will not be stored.

The clear button is used to cancel an entered value. For example, when a new parameter value has been entered, but the value is not ok, this value has to be cancelled. If the ENTER button is pushed in combination with the SHIFT button, the old parameter value is restored.

10) Shift button

This button has to be used to access the secondary function of a button. When a button is pushed without the shift button, it will have its normal function, indicated in white on the button. If a button is pushed in combination with the shift button the button will have its secondary function, indicated on the button with the same colour as the shift button. To use the secondary function of a button, first push the shift button, then push the button itself while holding the shift button. Release the button and after that release the shift button again.

11) Numeric keypad

These buttons can be used to enter a numeric value. For example in the program selection screen a program number can be entered with these buttons. Entering a new parameter value and entering a password can also be done with these buttons.

The numeric keypad buttons are also used in case of editing the name of a program. In this case they are used to enter characters (see chapter 6.4.2).

12) Temporary temperature set-point change

When a drying or cool-down cycle is active, the default set-point temperature as adjusted is set at the moment the drying or cool-down cycle starts. Sometimes it is necessary to manually adjust the temperature to a higher or lower set-point. This can be done with these buttons in combination with the SHIFT button (see item 10). If the SHIFT button (see item 10) is pushed in combination with the INCREASE TEMPERATURE button, the current temperature set-point will be increased by 5 degrees Fahrenheit (or 2.8 degrees Celsius). If the SHIFT button (see item 10) is pushed in combination with the DECREASE TEMPERATURE button, the current temperature set-point will be decreased by 5 degrees Fahrenheit (or 2.8 degrees Celsius). The controller uses Fahrenheit units internally but the interface units are configurable as either Fahrenheit or Celsius. When the interface temperature units is set to Fahrenheit increments of 5 degrees increase or decrease will be displayed. When the interface temperature units is set to Celsius the display will sometimes show an increment of 2 degrees and sometimes an increment of 3 degrees. This is because 5 degrees Fahrenheit is equal to 2.8 degrees Celsius but DOES NOT influence the actual increment, which is always 5 degrees Fahrenheit.

Please note that these changes in set-point are temporary. They do not change the adjusted value in the active program. This means that in the next program cycle, the settings adjusted in the program cycle will be used again. Also, if a temporary change is made in the drying cycle of the program, this doesn't influence the cool-down temperature setting adjusted.

13) Temporary time change

When a drying or cool-down cycle is active, the adjusted drying or cool-down time is set at the moment the drying or cool-down cycle starts. Sometimes it is necessary to manually adjust the time to a higher or lower value. This can be done with these buttons in combination with the SHIFT button (see item 10). If the SHIFT button (see item 10) is pushed in combination with the INCREASE CYCLE TIME button, the current time remaining in the drying or cool-down cycle will be increased by 5 minutes. If the SHIFT button (see item 10) is pushed in combination with the DECREASE CYCLE TIME button, the current time remaining in the drying or cool-down cycle will be decreased by 5 minutes.

Please note that these changes in time are temporary. They do not change the adjusted value in the active program. This means that in the next program cycle, the settings adjusted in the program cycle will be used again. Also, if a temporary change is made in the drying cycle of the program, this doesn't influence the cool-down time setting adjusted.


4) Overview screen

During normal operation, the display will show the overview screen. In this screen, the currently selected program number and name is displayed in the upper line. The lower line is used to display the current state of the machine. In case an alarm is active, the alarm text will be shown on the lower display. If the machine is running, the lower line is used to display temperatures and time left to finish cycle.

Before starting the machine, the overview screen may look like:

1 : [Program name]
Ready to start

The screen indicates that program number 1 is selected and that the machine is ready to start. If the start button is pushed, the software will check if all inputs are in the right state. If all inputs are ok, the cycle is started and the message 'ready to start' will be replaced by the current status of the drying program. The machine will start a drying cycle according to the adjustments made in program 1. If a cycle is running, the lower line can display 2 different lines:

 24 / 75 °C Drying


or




 30m  +  40m

Which line is displayed, depends on the setting in machine parameter 7 (see chapter 'Machine parameters'). This parameter is used to adjust if the status line should only indicate the temperature, only the times or if the status line should toggle between temperature and time.

4.1) Status line with temperature

As explained above, the status line with temperature may look like:

 24 / 75 °C Drying

The  symbol means that heating is active. The machine is warming up to reach or maintain the adjusted temperature. If the software temperature controller decides that heating should be off, the '+' symbol will disappear and the  symbol will be replaced by a  symbol, indicating that the heater output is off. If the heater output is on, the yellow LED will also be on (see chapter 4.4).






The 24 / 75 °C string indicates the current temperature and goal temperature. In this example, the current temperature is 24 °C and the goal temperature is 75 °C. In this example the temperature is displayed in degrees Celsius. It's also possible to use Fahrenheit units. This is adjustable with machine parameter 1 (see chapter 'Machine parameters').

The last text in the line indicates which step in the drying cycle is active. In this example, the drying step is active. When the drying step is completed the dryer will switch to cool-down mode, and the text 'Drying' will be replaced by 'Cooling down'.

4.2) Status line with times

As explained, the status line with times may look like this:

 30m  +  40m

The  symbol indicates that the drying step is active. The estimated remaining time for drying is 30 minutes. If the cool-down step is active, the  symbol will be replaced by the  symbol. The  +  symbol is a symbol for the total time remaining. The total time remaining is the estimated remaining drying time plus the estimated remaining cool-down time. In this example, the total estimated time left is 40 minutes. From this we can also derive that the estimated remaining cool-down time is 10 minutes. Because the estimated remaining drying time is 30 minutes and the estimated remaining total time is 40 minutes, the estimated remaining cool-down time is $40 - 30 = 10$ minutes.

4.3) Numeric display

Just above the graphical display, there are three '7-segment' displays are placed. These '7-segment' displays can only be used to display numbers and some simplified symbols. The '7-segment' displays will be referred to as the numeric display.

The numeric display is larger than the graphical display, which means that it can be read from further away. It is used to indicate the current alarm number, the estimated total cycle time left and to notify the user that a program is finished and that the batch is ready to be taken out.

If an alarm is active, the numeric display will toggle between '- - -' and the current alarm number. In this case, the lower line of the graphical display will show the alarm text corresponding with the alarm number. For a full explanation of all available alarms, see chapter 'Alarm and status messages'.

If a drying or cool-down cycle is running, the numeric display will show the estimated time left for the cycle in minutes.

In case the program has finished, the numeric display will toggle between '- - -' and empty. This indicates that the drying and cool-down has been done and that the batch is ready to be taken out of the dryer.

When the machine is not drying or has finished a program, and no alarms are active, the numeric display will only show '- - -'.

4.4) LED functions

The controller has 3 LED's in total, one yellow one next to the numeric display, a red one in the stop button and a green one in the start button.

The yellow LED indicates the status of the heating output. If the LED is on, the heater is output is on, and when it is off, the heater output is also off.

The red and green LED's are used to indicate the current machine status. The LED function table for the red and green LED is:

Red LED	Green LED	Meaning
On	Blinking	A warning or alarm is active. The upper numeric display will toggle between '---' and the alarm number. See chapter 7 for the available alarms.
Blinking	Blinking	A program cycle is finished and the controller is waiting for the batch to be taken out of the machine. The upper numeric display will toggle between '---' and empty.
On	Off	The stop button was pushed during a running cycle. If the stop button is pushed again the cycle will be cancelled and the machine will return to the 'ready to use' state. If the start button is pushed, the program cycle will resume.
Off	Blinking	The machine is ready to start. If the start button is pushed, the program cycle will begin.
Off	On	Program cycle running

5) Basic operation and functioning

The basic operation of the machine consists of the following steps:

- 1) Selection of a drying program
- 2) Starting the cycle
- 3) Program running
- 4) Program completed

During every one of these steps, actions can or have to be done by the user. This chapter describes which actions are possible and how to do the actions.

5.1) Selection of a drying program

Before a drying program is started, the user must make sure that the correct drying program is selected. The drying program is displayed in the upper line of the overview screen (see also chapter 4).

If the correct program is not selected (for example, a drying program for towels is selected, but the current machine load is a batch of sheets), the user must select another program. If the correct program has been selected, step 2 can be done (see chapter 5.2).

For choosing a program, there are 2 possibilities. If a pre-defined program can be used, chapter 5.1.1 is applicable. It is also possible to manually configure a 'single cycle' program. This can be used in cases where there is no suitable pre-defined program, for example if a batch is already partially dry, or in case of special material which is not normally done with this machine. In case a single cycle program is necessary, go to chapter 5.1.2.

5.1.1) Selecting an adjusted program

From the overview screen, the user can go to the program selection screen by pushing the SELECT PROGRAM button, or by pushing one of the numeric buttons 1 to 9.

In this screen, a pre-defined program can be selected with the numeric buttons 0 to 9 or with the ARROW UP and the ARROW DOWN buttons. The currently selected program number, together with the program name is displayed in the lower line of the display. If the arrow buttons are used in combination with the SHIFT button, the selected program will be increased or decreased by 10.

When the correct program has been selected, this has to be confirmed by pressing the ENTER button. When this button is pushed, the selected program will be activated and the overview screen is displayed again. When this has been done the cycle can be started (go to chapter 5.2).

It is also possible to use the START button. If this button is used, the current selected drying program will be chosen, the drying program will be started immediately and the main screen is activated again. This means that cycle start as described in chapter 5.2 is executed immediately. If no alarms are active, go to chapter 5.3.

5.1.2) Entering a single cycle program

As explained in chapter 5.1, it is also possible to enter a single cycle program. This is used in special circumstances like partially dried batches and special materials. If the SELECT PROGRAM button is used in combination with the SHIFT button, the screen for entering a single cycle is displayed. In the single cycle screen, a self chosen drying time and temperature can be entered. By default, the values are as defined in program 50 and these values can then be adjusted by the user.

The screen will start up with the edit-field on the drying time. If necessary change the drying time value with the PLUS or MINUS buttons or with the NUMERIC buttons and confirm with the ENTER button. When the ENTER button is pushed, the cursor will move to the drying temperature. Change the value if necessary in the same way and confirm with the ENTER button. When the ENTER button is pushed

while the cursor is on the drying temperature, the overview screen is activated again, and the cycle is ready to be activated (see chapter 5.2).

In the screen for entering a single cycle drying time and temperature, the cursor can be moved to the next or previous edit-field with the ARROW UP and ARROW DOWN buttons.

When a single cycle program is finished, the controller will automatically switch back to the pre-defined program which was last used before the single cycle was started.

5.2) Starting the cycle

After the correct program has been selected, a program cycle can be started with the START button. If this button is pushed, the software will check if all inputs are in the correct state. If so, the cycle is started and step 3 is activated (see chapter 5.3). If one of the inputs is not in the correct state, the lower line in the display will show an alarm text and the numeric display above the graphical display will start blinking with the alarm number. A full explanation of the available alarms and their cause can be found in the chapter 7.

5.3) Program running

In this step the program cycle is running. A program cycle can be a drying step, a cool-down step or both. When running, the 2nd line in the overview screen will show the current status (see chapter 4).

In case an alarm occurs, the machine will be stopped by the controller and the program cycle will be paused. The same will happen if the STOP button is pushed.

When cause of the alarm has been corrected, the alarm can be reset with the START button. After that, 'Waiting for cycle restart' will be displayed. The same will happen if the STOP button is pushed once.

If the message 'Waiting for cycle restart' is displayed, the cycle can be restarted with the START button and the pause situation is cancelled. If, in this case, the STOP button is pushed, the complete program will be cancelled and the step described in chapter 5.1 is activated.

When the drying step and the cool-down step are finished, the step described in chapter 5.4 is activated.

5.4) Program completed

This step is activated when a program cycle is finished. When the program cycle is completed, the beeper will sound for the time defined in machine parameter 6 (see chapter 6.4.3). This beeper sound will restart every 2 minutes.

After finishing a program the machine will either stop or the anti-crease cycle will start if this is selected. The anti-crease function can be enabled or disabled in the program parameters (see chapter 6.4.1).

If anti-crease is enabled the machine will be stopped for 2 minutes after finishing a program cycle. After 2 minutes, anti-crease starts. This means that the drum direction and speed as defined in the program will be used and the blower will be off.

Note:

Because the blower output is off during anti-crease operation, the anti-crease function will not work if the blower and the drum motor are both connected to output 7 during installation of the controller.

If a cycle is completed, the dryer will stay in this step (audible signal and/or anti-crease operation) until the door is opened. When the door is opened, the controller assumes the dryer will be emptied and will go back to the 'ready to start' state as described in chapter 5.1.

6) Menu structure

If a parameter setting needs to be changed, a counter needs to be read or reset or test programs need to be run, these items can all be accessed via the main menu.

The main menu can be accessed by pushing the set-up button in the main screen. The set-up button is the SHIFT button in combination with the HOME button.

Press the SHIFT and HOME button combination and the main menu will be displayed. Items can be selected from the menu by using the ARROW UP and/or ARROW DOWN button. Confirming the choice of an item is done by pressing the ENTER button. Some items give direct access to functions, some items will open another menu. The menu tree is as follows:

MAIN MENU	->	DELAYED START	
	->	COUNTER MENU	-> COUNTERS PER PROGRAM -> COUNTERS PER DAY -> COUNTERS IN TOTAL -> NON-RESETTABLE COUNTERS
	->	EDIT PARAMETER MENU	-> EDIT PROGRAM PARAMETERS -> EDIT PROGRAM NAME -> EDIT MACHINE PARAMETERS
	->	TEST PROGRAM MENU	-> VIEW STATUS OF INPUTS -> VIEW STATUS OF OUTPUTS -> TEST OUTPUTS MANUALLY -> CHECK POWER SUPPLY VOLTAGE
	->	SYSTEM SETUP MENU	-> ADJUST DATE & TIME -> CHANGE LANGUAGE -> RESTORE FACTORY SETTINGS -> RESET MAINTENANCE REQUEST
	->	ALARM HISTORY	
	->	EDIT MACHINE CONFIGURATION	
	->	CONTROLLER INFORMATION	

6.1) Entering a password

For gaining access to some of the menu items mentioned above, a password is necessary. The controller will not ask for a password unless it is needed to approve access to a menu item. If an item is password protected the password screen will be activated and the controller will prompt to enter a password.

Passwords are available in different levels:

-	Level 1	1234	Reset counters per program Edit program parameters Edit program name Test outputs manually
-	Level 2	9999	Adjust date & time Reset counters in total Edit machine parameters Change language Restore factory settings

If a password is entered, it will remain valid for 10 minutes. If no action which requires a password is undertaken for 10 minutes, the password level will be reset to 0.

A special password (1111) is available for resetting the maintenance request (see chapter 6.6.4)

6.2) Delayed start

In the M720 controller it is possible to define a delayed start. If this menu item is chosen, the screen for entering the start delay will be displayed.

In this screen the number of hours and minutes delay can be entered. Changing values can be done with the NUMERIC keys and with the PLUS and MINUS buttons. Changing the cursor to another edit-field can be done with the ARROW UP and/or ARROW DOWN buttons. Confirming a value must be done with the ENTER button.

If the ENTER button is pushed when the cursor is on the minute field, the delayed start will be activated and the overview screen will be activated again. If both the number of hours and the number of minutes are set to 0, the delayed start timer will be preset to 30 seconds, which is the minimum time for a delayed start. The maximum time adjustable for a delayed start is 11 hours and 59 minutes.

In the overview screen, the message 'delayed start in:' will be displayed, followed by the time until the machine will start in HH:MM:SS format.

The dryer will count down until the delayed start time displayed is 0, and then it will start the selected program. For safety reasons, the beeper will sound 5 seconds before the machine starts.

If delayed start is activated, and a program cycle is started manually, the delayed start will be cancelled. Cancelling the delayed start can also be done with the STOP button.

6.3) Counter menu

If the item 'Counter menu' is chosen from the main menu, the screen with the counter menu will be displayed. In this menu, an item can be selected with the ARROW UP and/or ARROW DOWN button. Confirming the choice of an item must be done with the ENTER button

The M720 dryer controller has 4 sets of counters. The first set is called 'Counters per program'. Every drying program has its own counters. The second and third set are for a counter set per day ('Counters per day') and counter set with totals of all programs and all days ('Counters in total'). The fourth set is a non-resettable counter set, used to read counters processed since the controller was fabricated.

6.3.1) Counters per program

With the counter set 'Counters per program' the user can read how many batches and how many operating minutes have been done in a certain program. If the item 'Counters per program' is chosen from the counter menu, the counters of the current active program will be displayed. On the 1st line the number and name of the program can be seen. The 2nd line has the name of the counter, followed by the value of the counter.

With the PLUS and MINUS buttons the counters of the next and previous program can be viewed. Scrolling through the available counters per program is done with the ARROW UP and ARROW DOWN buttons. There are 2 different counters:

Number of batches	The number of batches processed in this program since the last reset
Running minutes	The number of minutes a program cycle has been active using this program since the last reset.

Resetting the counters of a program can be done by pushing the CLEAR button (SHIFT button and ENTER button). Depending on the adjustment in machine parameter 16, the controller may ask for a password. Password level 1 is necessary to be able to reset the counters of a program. If the clear button is pushed and the password level is sufficient, all counters of this program will be set to 0.

6.3.2) Counters per day

With the counter set 'Counters per day', the user can read how many batches and how many operating minutes have been done on a certain day. The controller saves the production data of the last 50 days the machine has been used. After 50 days, the oldest record will be deleted and replaced by a record of the current date.

If, in the 'Counter menu' the item 'Counters per day' is chosen, the counters of the current day will be displayed. On the 1st line, the date can be seen in DD-MM-YYYY format. With the PLUS and MINUS buttons, the counters of the next and previous day can be viewed. With the ARROW UP and ARROW DOWN buttons, one can scroll through the available counters per day. In this case there are 2 different counters:

Number of batches	The number of batches processed this day
Running minutes	The number of minutes a program cycle has been active this day.

It is not possible to reset the day counters. This is also not necessary since a new counter record will start from 0 automatically every day.

To be able to use the information of the 'counters per day', it is important to ensure date and time are adjusted correctly. See chapter 6.6.1.

6.3.3) Counters in total

With the counter set 'Counters in total', the user can see how many batches and how many hours the machine has run in total, so not depending on the day or the program. Selecting the item 'Counters in total' from the counter menu will display the total counters. With the ARROW UP and ARROW DOWN buttons one can scroll through the available total counters. In this case there are 2 different counters:

Number of batches	The number of batches processed in total since the last reset.
Running hours	The number of hours the machine has been running since the last reset.

Resetting the total counters can be done by pushing the CLEAR button (SHIFT button and ENTER button). Password level 2 is necessary to be able to reset the total counters. If the clear button is pushed and the password level is not sufficient, the controller will first ask for a password. If the password level is sufficient, all total counters will be set to 0.

6.3.4) Non-resettable counters

With the counter set 'Non-resettable counters', the user can see how many batches and running hours the controller has done since it was fabricated. Also the maintenance request counter can be viewed in this list (see machine parameter 5 and chapter 6.6.4).

With the ARROW UP and ARROW DOWN buttons, one can scroll through the available counters. In this case there are 3 different counters:

Number of batches	The number of batches processed in total since fabrication.
Running hours	The number of hours the machine has been running since fabrication.
Maintenance cycles	The number of batches still to do until a maintenance request will be done (see also machine parameter 5 and chapter 6.6.4).

As the name suggests non-resettable counters cannot be reset. Also they are saved in EEPROM memory and not in battery backed-up memory. This means that, unlike the other 3 counter sets, these counters will not be lost in case the battery is empty or removed.

6.4) Edit parameter menu



The controller has 3 sets of parameters. There are parameters which can be adjusted specifically for a program, so a program can be set-up to process a specific material. These parameters are the so-called 'program parameters'. The 'machine parameters' are general parameters which are always used, regardless of the active program. 'Configuration parameters' are parameters which describe the options in the machine and are typically set by the manufacturer. 'Program parameters' and 'machine parameters' can be accessed via the 'Edit parameter menu' item in the main menu. 'Configuration parameters' can be accessed via the separate item 'Edit configuration parameters' in the main menu. The 'Edit parameter menu' is also used to change the name of a program.

If, in the main menu, the item 'Edit parameter menu' is selected, this menu will be activated. In this menu, an item can be selected with the ARROW UP and/or ARROW DOWN button. Confirming the choice of an item must be done by pressing the ENTER button

6.4.1) Edit program parameters

The program parameter list is a list of parameters which can be adjusted to set-up a specific program. The parameters in this list are only used in the current program. To edit program parameters, password level 1 (1234) is required.

In the 'edit program parameters' screen, another parameter can be selected with the arrow buttons up and down. A value can be changed with the plus and minus buttons, or with the numeric buttons. Changing the value must be confirmed by pressing the enter button. The upper line will show the number and name of the parameter, followed by the value.

On the lower line, the maximum and minimum limit will be displayed. The  icon indicates if it is possible to still move up or down in the list, and the  icon is displayed to indicate if it is possible to increase or decrease selected value.

If the shift button is used in combination with the arrow buttons the controller will move to the first or last item in the list. If the shift button is used in combination with the plus and minus buttons, the value will be increased and decreased in larger steps. The following program parameters are available:

01) Drying method

As standard the controller is installed with 1 temperature sensor. In this case only the parameter 'Time' is available in the drying method setting of the program menu. If the machine is equipped with a second temperature sensor, or with an infrared sensor, an additional parameter 'Temp' is available for controlling how drying is handled. If this parameter is set to 'Time', the program will do drying purely based on time, which means a drying step will always last just as long as the adjusted drying time (see program parameter 6). If this parameter is set to 'Temp', the drying step will last until the controller has detected the batch is dry. After that, the defined drying time is started. If no 2nd temperature sensor and no infrared sensor are installed (see chapter 6.8), this parameter will not be visible and drying will always be purely time-based.

02) Material type

This parameter can be used for purposes of defining drying programs per material type. If the use of this parameter is enabled in the machine configuration (see chapter 6.8), this parameter can be used to preset a drying program as a material (for example cotton, polyester or wool). If this option is configured the machine will use pre-defined automatic settings for the drying and cool-down cycle. If the use of this parameter is disabled, it will not be visible in the menu.

06) Drying time

The time the drying step is activated (see also parameter 1).

07) Drying temperature

The target temperature for drying during the drying step. If the drying time is set to 0 (parameter 6), this parameter will not be visible.

10) Cooldown time

The maximum time the cool-down step may last. If the adjusted cool-down temperature (parameter 11) is not reached within this time, the program will finish anyway.

11) Cooldown temperature

The target temperature in the cool-down step. If this temperature is reached in the cool-down step, the program will finish.

13) Drum direction

The direction of the drum during drying, cool-down and anti-crease. If a reversible drum is configured in the machine configuration (see chapter 6.8), this parameter can be used to set the drum direction.

Left: Only turn left (output 5), drum will never stop

Right: Only turn right (output 6), drum will never stop

Rev: Toggle between left (output 5) and right (output 6), runtime and stop time adjustable with program parameters 15 and 16)

If no reversible drum is configured, this parameter will not be visible.

14) Drum speed

If the machine is equipped with a drum with frequency inverter (see chapter 6.8, machine configuration), this parameter can be used to adjust the drum speed during drying, cool-down and anti-crease. The value of this parameter is a percentage of the maximum speed. So if this parameter is set to 50%, the drum will run at half the maximum speed.

When no drum with frequency inverter is installed, this parameter will not be visible.

15) Drum stop time

If the machine is equipped with a reversible drum motor, and program parameter 13 is set to reversing, this parameter allows the time the drum will stop when switching direction to be defined. So, after running for the time defined in parameter 16, the drum will stop for the time defined in parameter 15 and then start again in the other direction.

If no reversible drum is installed or the drum direction is not set to reverse, this parameter will not be visible.

Note:

This value is an additional value to the minimum stop time, which is 4 seconds. So, for example, if this parameter is set to a value of 6, the stop time will be $6 + 4 = 10$ seconds.

16) Drum run time

If the machine is equipped with a reversible drum motor, and program parameter 13 is set to reversing, this parameter is the time the drum runs in one direction. After running for the time defined in parameter 16, the drum will stop for the time defined in parameter 15 and then start again in the other direction.

If no reversible drum is installed or the drum direction is not set to reverse, this parameter will not be visible.

19) Anti crease funct.

This parameter indicates if the anti-crease function is enabled in this program. If a program is finished, the drum will always stop for 2 minutes. If anti-crease is enabled, after these 2 minutes the drum will start to run again. This will continue until the door is opened. During anti-crease the blower will not be on. This means that if the drum motor is connected together with the blower motor, the anti-crease function cannot work.

22) Max. temp rise

The maximum temperature rise rate in degrees per minute during a drying cycle. During drying the controller will adjust the temperature control function so that the temperature will not rise more than

this adjusted maximum. If this value is set to 0, no maximum rise is active, and the controller will try to reach goal temperature as soon as possible.

23) Max. temp fall

The maximum temperature fall rate in degrees per minute during a cool-down cycle. During cool-down the controller will adjust the temperature control function so that the temperature will not fall more than this adjusted maximum. . If this value is set to 0, no maximum fall is active, and the controller will try to reach goal temperature as soon as possible

6.4.2) Edit program name

A program name can be defined for each program. This name can describe, for example, the type of material the program has been set-up for. The maximum length of a program name is 32 characters and the maximum number of pixels is 170.

If program names are edited in the controller, only 'western European' characters can be used. When the item 'Edit program name' is chosen and the current program name has characters which are not in the range of 'western European' characters, these characters will be replaced by a '.'.

When the screen is activated, the cursor will be on the first character. The cursor can be moved with the ARROW UP and ARROW DOWN buttons.



Changing the character where the cursor is on can be done with the numeric keypad, in more or less the same way sms-messages are created on cell-phones. The list with characters per button is;

Button number	Character sequence
1	, . / \ () 1
2	a b c A B C 2
3	d e f D E F 3
4	g h i G H I 4
5	j k l J K L 5
6	m n o M N O 6
7	p q r s P Q R S 7
8	t u v T U V 8
9	w x y z W X Y Z 9
0	0 [SPACE]

6.4.3) Edit machine parameters

The machine parameter list is a list with parameters which can be adjusted to set-up general parameters in the machine. These parameters are used for all programs. Because they are valid for all programs, machine parameters are only accessible via the level 2 password.

In the 'edit machine parameters' screen parameters can be selected with the arrow buttons up and down. A value can be changed with the plus and minus buttons, or with the numeric buttons. Changing the value must be confirmed with the enter button. The upper line will show the number and name of the parameter, followed by the value.

On the lower line, the maximum and minimum limit will be displayed. If the  icon is shown, it is possible to move up or down in the list, if the  icon is shown it is possible to increase or decrease the value.

If the shift button is used in combination with the arrow buttons, the controller will move to the first or last item in the list. If the shift button is used in combination with the plus and minus buttons, the value will be increased or decreased in larger steps.

The following machine parameters are available:

01) Tmp in fahrenheit

Put this parameter to 'yes' if all temperature settings and displays should be displayed in Fahrenheit units instead of Celsius. If this parameter is 'no', all temperature settings and displays will be displayed in Celsius units.

Note:

This value only changes the units used for displaying temperature values. Internally the controller always works with Fahrenheit units.

05) Maintenance cycle

Use this parameter for setting the number of batches until a maintenance request is done. If, for example, the value of this parameter is 500 then as soon as 500 batches have been done the controller will show the message 'Maintenance request' when the machine is in rest. The maintenance counter can be reset again in the 'System Setup' menu, item 'Reset maintenance request' (see chapter 6.6.4). The number of batches which still can be done until a maintenance request is displayed, can be read in the non-resettable counters screen (see chapter 6.3.4).

If this parameter is set to 0, the maintenance request option is disabled and no maintenance request will be displayed.

06) Finished beeptim.

When a program is finished, the controller will activate the beeper. This parameter is the time the beeper will beep when a cycle is finished. This time is repeated every 2 minutes until the door has been opened.

07) Overview status

This parameter is used to control the 2nd line in the display in the overview screen when the machine is running.

- Value 0: Toggle between current time left (see value 1) and current temperatures and step (see value 2)
Value 1: Only show current temperature, temperature set-point and current step.
Value 2: Only show time left in current step and total time left until program is finished.

11) RS485 Stationnr.

The controller is equipped with a so-called RS485 port to communicate with a PC for downloading translations and monitoring. Every controller in a network must have a unique station number. This parameter is used to set the station number of this controller.

12) RS485 baudrate

The controller is equipped with a so-called RS485 port to communicate with a PC for downloading translations and monitoring. This parameter is used to adjust the communication speed of the RS485 port.

- Value 0: 115.200bps
Value 1: 38.400bps
Value 2: 9.600bps

Every controller in a network must be adjusted to the same communication speed. In cases where long cables are used to connect controllers to the network, or in case of difficulties with communication between PC and controller, often a lower communication speed is necessary. When this parameter is changed, the controller must be restarted.

16) Cnt.reset no pass

If this parameter is set to 'yes', the counters per program (see chapter 6.3.1) can be reset without a password. If this parameter is set to 'no', password level 1 (1234) is needed to be able to reset the counters per program.

20) Use coin box

If a coin box is configured in the machine configuration (see chapter 6.8), this parameter is used to adjust if the coin box should be used (value 'Yes') or should not be used (value 'No'). If no coin box is defined in the machine configuration, this parameter will not be visible. This function is not implemented in the current version, so this parameter should always have a value 'No'.

21) Coin box 1 time

If a coin box is defined in the machine configuration (see chapter 6.8), this parameter is used to adjust the number of minutes credit if a coin of type 1 has been deposited. If no coin box is defined in the machine configuration, this parameter will not be visible. This function is not implemented in the current version, so this parameter should always have a value of 0.

22) Coin box 2 time

If a coin box is defined in the machine configuration (see chapter 6.8), this parameter is used to adjust the number of minutes credit if a coin of type 2 has been deposited. If no coin box is defined in the machine configuration, this parameter will not be visible. This function is not implemented in the current version, so this parameter should always have a value of 0.

26) Rotation time-out

If a rotation sensor is defined in the machine configuration (see chapter 6.8), this parameter is the time the drum is allowed to turn without a signal from the rotation sensor. For example, if the value of this parameter is 10, and the drum has been turning for 10 seconds without a signal from the rotation sensor, the machine will stop and display an alarm. The value of this parameter is based on when the drum is running at full speed. If the machine is equipped with a frequency inverter, the time-out value is automatically recalculated with regard to the adjusted drum speed. For example, if the time-out value is 10 and the adjusted drum speed is 50%, the internally calculated time-out value will be 20 seconds.

If no rotation sensor is defined in the machine configuration, this parameter will not be visible.

27) Jog drum speed

If jog buttons and a drum with frequency inverter have been defined in the machine parameters (see chapter 6.8), this parameter is used to adjust the drum speed in case jogging is active. The value is a percentage of the maximum speed. For example, if 30% is adjusted, the speed of the drum motor in case of jogging will be 30% of the maximum.

If no jog buttons or no drum with frequency inverter is adjusted, this parameter will not be visible.

30) Heater reset time

Some types of heater require a reset signal before they will restart after a fault alarm. When a program is started the output for resetting the heater will be activated (output 1) as standard. This parameter is the number of seconds the output will be on when starting a program. The value used will depend on the type of heater (refer to the heater's instructions for this).

31) Blower clean time

When a program is started the output for an optional clean signal (like an air blast) for the blower will be activated (output 3). This parameter is the number of seconds the output will be on when starting a program.

32) Blower WYE del.

If the machine is equipped with a star/delta switch to start the blower motor this parameter is the delay for switching the blower star/delta switch from on to off after restarting the blower. For more details, see chapter 2.3.2, output 4.

33) Del. check airflow

When a program is started, the controller will check if the airflow switch (input 3) is in the 'off' position. After that the blower will be started. After starting the blowers, the airflow switch should go to the 'on' position within a given period otherwise an alarm will be displayed. This parameter is the delay interval between the moment the blower starts and the moment the airflow switch should be in the 'on' position.

6.5) Test program menu

To be able to track malfunctions and to check correct functioning of all inputs and outputs, the M720 controller is equipped with various test functions. These test functions can help service staff to find malfunctioning inputs or outputs faster.

If the item 'Test program menu' is selected from the main menu, this menu will be activated. In this menu an item can be selected with the ARROW UP and/or ARROW DOWN button. Confirming the choice of an item must be done with the ENTER button.

6.5.1) View status of inputs

In this screen all available inputs can be monitored. When the screen is activated, the module number will be set to 0. Module 0 is the controller itself. If extension boards are connected, an extension board can be selected with the ARROW UP and/or ARROW DOWN button. If no extension boards are connected, the arrow buttons will not be visible. Module number 1 is the extension board with address number 1, module 2 is the extension board with address 2, and so on. See chapter 2.2 for an explanation of how to set-up an address of an extension board.

After selecting a module number, an input number can be chosen with the PLUS and MINUS buttons. The dryer controller itself has 16 inputs, extension boards each have 8 inputs. If module number 0 is selected, the input number can vary between 1 and 16. If an extension board (module number 1 to 8) is selected, the input number can vary between 1 and 8.

On the lower line of the display, the current status of the input is shown. If an input receives a 24V signal the status of the input will be 'ON' and if no signal is received on the input, the status of the input will be 'OFF'.

The following example will explain how to test the 'door closed' input. The input for door closed is input 1 on the dryer controller. To check the status of this input first select module number 0 with the ARROW UP and/or ARROW DOWN button. Module number 0 means viewing the inputs on the dryer controller itself. After that select channel number 1 with the PLUS and/or MINUS buttons. Channel number 1 means input 1. If the module number is set to 0, and the channel number is set to 1, the input status of the 'door closed' input is shown. If the door is closed, the status of the input should be 'ON'. If the door is opened, the status of the input should change to 'OFF'.

6.5.2) View status of outputs

The 'View status of outputs' screen can be used to check if the controller board is activating an output. Viewing the status of an output can be done while the machine is running. Selecting a module number and channel number is done in the same way as in the 'View status of inputs' screen (see chapter 6.5.1). The main difference between viewing the status of the inputs and viewing the status of the outputs is the number of available outputs on the dryer controller itself. The dryer controller has 8 relay outputs and 1 digital outputs. This means that if module number 0 is selected, the channel number can be varied between 1 and 9.

6.5.3) Test outputs manually

As the name already says, this test program can be used to manually activate an output. Because the user takes over control of all available outputs, password level 1 is necessary to be able to run this test program. Also, if a program cycle is active, this cycle will be stopped to prevent the dryer from restarting automatically if the user quits this test program.

Selecting a module and channel is done in the same way as selecting an output in the 'View status of outputs' screen (see chapter 6.5.2 and chapter 6.5.1).

The screen will look the same as the 'View status of outputs' screen, with the difference that the status of the output is controlled with the ENTER button. If the right output is selected by setting the right module and channel number, the output will be in the 'OFF' state initially. When the ENTER button is pushed, the output will be switched on, and the state will change to 'ON'. The output will stay in the

'ON' state as long as the ENTER button is pushed and will return to the off state when the enter button is released.

The following example explains how to test the blower output. The blower output is output number 7 on the dryer controller. If necessary, select module number 0 with the ARROW UP and/or ARROW DOWN button. Module number 0 means testing the outputs on the dryer controller itself. After that, select channel number 7 with the PLUS and/or MINUS buttons. Channel number 7 means output 7. If the module number is set to 0, and the channel number is set to 7, the blower output is selected. If the ENTER button is not pushed, the output status will be 'OFF'. If the ENTER button is pushed, the controller will switch on the relay at output 7 and the state will go to 'ON'.

6.5.4) Check power supply voltage

The dryer controller has an on-board facility to monitor the voltage supplied to the controller. If the power supply voltage drops below the low voltage limit or rises above the high voltage limit, all outputs will be switched off and an alarm message is displayed (see chapter 7, Alarms).

When 'Check power supply voltage' is chosen in the 'Test program menu', the screen will show the current power supply voltage. In case of an AC power supply, the voltage is rectified, which means that the displayed voltage is higher than the AC voltage supplied to the controller. This factor is around 1.4. So, if the power supply is 24VAC voltage, this screen will show approx. $1.4 * 24 = 33.6$ Volts. If DC power is supplied to the controller, this doesn't have to be rectified, which means that the value in the display is more or less the same value as really supplied to the controller.

6.6) System setup menu

The 'System setup menu' is a menu with items which are not directly related to the control functions of the machine itself but define the complete installation and user interface. The available items are used to set-up some extra features of the controller.

6.6.1) Adjust date & time

Password level 1 is required to be able to adjust current date and current time. When the item 'Adjust date & time' is chosen from the 'System setup menu' the screen will show the current date & time in the display, with the cursor blinking on the first edit-field (the day field in the date). The current date can only be viewed and edited in a DD-MM-YYYY format. The displayed time is in HH:MM format.

The adjusted date and time are internally used in the controller to create an alarm history list with start times and active times (see chapter 6.7) and for the counters per day. At the moment a new day begins according to the date and time adjusted in this controller, a new counter record for the new day will be created (see chapter 6.3.2).

To adjust the value of the field where the cursor is, use the numeric buttons and / or the PLUS and MINUS buttons. Confirm the new value with the ENTER button. The cursor can be moved to the next or previous edit field with the ARROW DOWN and ARROW UP button.

6.6.2) Change language

Password level 2 is required to change the language of the controller display. When 'Change language' is chosen from the 'System setup menu', the first line will tell the user to select a language from the list. The 2nd line shows the name of the current language, like for example 'English'. Now, a language can be selected with the ARROW UP and ARROW DOWN buttons. When the right language is selected, this choice can be confirmed with the ENTER button,

Because the M720 controller has a full world-wide character set, it is possible that the controller is set to a language which can not be read and/or understood. This can also happen if the language is accidentally changed to another language.

If this happens, it would be difficult to go through the available menus and find the 'Change language' item again. Therefore, a work-around is available. When switching the controller off and on again, the

start-up logo (or an empty screen) will be shown for around 4 seconds. If, during this time, the SHIFT button and the ENTER button are held simultaneously, the screen to change the language will be activated as well, so another language can be selected.

6.6.3) Restore factory settings

Restoring factory settings should normally not be necessary because all parameters are stored in non-volatile memory, which does not need a battery to retain its data. But, in some cases it can be useful to be able to go completely back to factory settings.

If the item 'Restore factory settings' is chosen from the 'System setup menu', and the password level is sufficient, the screen for restoring factory settings will be displayed. If the password level is too low, the password screen will be activated. A password level 2 is necessary to get access to the factory settings screen.

If the screen for restoring factory settings is displayed, the factory settings can be restored by pushing the SHIFT button and NUMERIC 9 button at the same time. When factory settings are restored, the overview screen will be activated again. Because restoring the factory settings is a time consuming process, the normal program cycle can be halted for a while. During the time needed to restore all factory settings, the beeper will sound continuously.

Please note that restoring factory settings will restore the factory settings of all drying programs and the settings of the machine parameters. These parameters are set as described in chapter 8. Restoring factory settings does **not** change the configuration parameters. They will not be influenced by this operation.

6.6.4) Reset maintenance request

With machine parameter number 5 (see chapter 6.4.3) it is possible to set a maintenance request count. For example, if machine parameter 5 is set to 500, and 500 batches are done the display will show 'Maintenance request' before the machine can be started for a new program cycle (see also chapter 7, Alarms). This 'Maintenance request' will be active until the message is reset via the 'System setup menu item 'Reset maintenance request'. If this item is selected a special password must be entered (see chapter 6.1). For resetting the maintenance request the password is 1111. The remaining number of batches until the next maintenance request message is displayed can be seen in the 'non-resettable' counter set, see chapter 6.3.4.

6.7) Alarm history

The alarm history list can be viewed by selecting 'Alarm history' in the main menu. The alarm history is a list with the last 50 alarms, warnings and messages which have occurred. The alarm history list will be reset each time the controller restarts.

In the alarm history screen the upper line displays which record number is currently displayed. Scrolling through the list of records is done with the ARROW UP and ARROW DOWN buttons. The maximum number of items saved is 50.



, The time the alarm started is shown on the right side of the upper line. The lower line shows the alarm number and alarm text (see chapter 7 for a complete list of all available alarms, warnings and other messages). The number of minutes the alarm has been active is displayed on the right side of the lower line. The maximum value is 240. When an alarm is active for longer than 240 minutes (or 4 hours) the controller will stop counting. The minimum time is 1 minute. If an alarm is active for less than 1 minute the number of minutes will be set to 1 anyway. If the alarm is still active, a '?' will be shown instead of a value.

In order for the alarm history list work properly it is important that the controller date and time are set to the correct values. Chapter 6.6.1 describes how to the correct date and time.

6.8) Edit machine configuration

The machine configuration is a list of parameters which can be adjusted to set-up the available options of the machine. Because these parameters influence the way the machine works and because setting the wrong values can cause a complete machine stop, these parameters are only accessible with the highest password level. Usually, these parameters are adjusted once after installing the machine. If the configuration has been set-up properly during installation, there is no need to change the values unless there are changes to the physical installation.

In the 'edit machine configuration' screen, a parameter can be selected with the arrow buttons up and down. A value can be changed with the plus and minus buttons, or with the numeric buttons. Changing the value must be confirmed with the enter button. The upper line will show the number and name of the parameter, followed by the value.

On the lower line, the maximum and minimum limit will be displayed. With the  icon is indicated if it is possible to still move up or down in the list, with the  icon is indicated if it is possible to increase or decrease the value.

If the shift button is used in combination with the arrow buttons, the controller will move to the first or last item in the list. If the shift button is used in combination with the plus and minus buttons, the value will be increased and decreased in larger steps.

The following configuration parameters are available:

01) Startup logo nr.

When the controller starts up a start-up logo will be displayed for 5 seconds. Depending on manufacturer and distributor, it can be useful to change the start-up logo. If the value of this parameter is 0, no start-up logo will be displayed.

04) 2nd temp. sensor

This parameter indicates if a 2nd temperature sensor is connected. This means that an extra temperature sensor is mounted at the air inlet of the machine.

05) Infrared sensor

This parameter indicates if an infrared sensor is available to measure the linen temperature.

07) Reversible drum

This parameter indicates if the drum can turn left and right with a reverse relay. If this parameter is set to yes, output 5 and 6 are used for the motor direction and in the program parameters, parameters 13, 15 and 16 are used to adjust the motor direction, motor run time and motor stop time.

08) Drum with freq.inv

This parameter indicates if the drum motor is controlled with a frequency inverter. If so, the drum speed can be controlled by connecting the analogue output of the controller to the analogue input of the inverter. With program parameter 14 the drum speed can be adjusted per program.

11) Use material para

This parameter indicates if the 'material' parameter per program has to be used. Is not implemented in the current revision of the controller, so always set this parameter to 'No'.

12) Status output func

This parameter sets the function of the status output (output number 2), which can be used to give a signal to an external system or for example to connect an alarm light.

Value 0: Output on when a drying cycle or cool-down cycle is busy. In this case the output will be switched on when a drying cycle starts and will switch off when the program is finished. This means that the output will always be on, even if the machine is stopped by an alarm or by the user, until a program is completed.

- Value 1: Output on when a program is finished. If a program has been finished, the output will be switched on and will stay on until the door is opened or until the program cycle is stopped by pushing the stop button twice.
- Value 2: Output on when the machine is stopped because of an alarm while a drying cycle or cool-down cycle was active.
- Value 3: Output on when a program is finished (see value 1) or when an alarm is active during a program cycle (see value 2).

16) Coin box present

This parameter indicates if the machine is equipped with a coin box. If so, machine parameters 20, 21 and 22 can be adjusted to set-up the machine for working with a coin box. This function is not implemented in the current revision of the controller, so always set this parameter to 'No'.

17) Rotation sensor

This parameter indicates if the machine is equipped with a rotation sensor. If so the rotation sensor should be connected to input 7. Please note that the rotation sensor must be a 24VDC sensor as the use of 24VAC sensors is not possible. If this parameter is set to 'Yes', the machine will monitor the sensor when the drum is running. If the drum is running and the rotation sensor has not been detected for a given time interval (see 6.4.3, item 26) the machine will be stopped and an alarm will be displayed.

20) Jog buttons

This parameter indicates the presence of jog buttons. If set to 'Yes' the jog buttons should be connected to inputs 12 and 13. Jog buttons allow the user to jog the drum motor when the machine is in a stop situation, the emergency stop is not active and the door is closed. If the drum motor is controlled by a frequency inverter a separate motor jog speed can be defined with machine parameter 27.

26) EDG replacement

If the controller has to replace an existing machine with an EDG controller, this parameter has to be set to 'Yes'. If set to 'Yes', the machine will perform other checks on the filter door/drawer open input and the overload input. This has to be done so the controller can be replaced by just using the existing connectors without the need of changing the wiring of the switches.

Setting this parameter to 'Yes' does also overrule the function of the inputs 8, 9, 10 and 15 (air pressure switch, overheating contact, emergency stop/safety switches and fire suppression input). This means that if an EDG controller is replaced with an M720 controller in an existing machine, this parameter has to be set to 'Yes' and these inputs will not be monitored.

Please note that if an EDG controller has to be replaced by an M720 dryer controller, the temperature sensor should also be replaced.

6.9) Controller information

The 'Controller information' screen shows the current hardware and software version, and the serial number of the controller. This information can, for example, be used to check if the correct version of the manual is being used as a reference.. This information must also be provided with each support request.

7) Alarms

If the machine detects an alarm or a warning a message will be displayed on the 2nd line of the overview screen. In some cases, the numeric display above the graphical display will also blink with the alarm number.

Alarms can be reset with the start button. Only one alarm is reset at a time so if multiple alarms are active the start button must be pushed once for each alarm. The alarms are the messages with number 1 to 20.

Warnings can also be reset with the start button but will also automatically reset if the cause is solved. The warnings are the messages with number 21 until 30.

Status messages often do not require action. If a status message requires action this is described in the explanation of the message. The status messages are the messages with number 31 until 40.

All alarms, warnings and messages which occurred can be checked in the alarm history screen (see chapter 6.7).

The following alarms, warnings and messages can be displayed:

001) Emergency stop

The input for the emergency stop and/or safety switches (input 10) is, or has been, in the 'off' state. This means the emergency stop has been pushed or one of the safety switches has been activated.

002) Overload protection

The input for the overload contacts (input 4) is, or has been, in the 'off' state. This means one of the overload protections is activated.

003) Error frequency inverter

The input for the error of the frequency inverter (input 11) is, or has been, in the 'off' state. This means that (one of) the frequency inverter(s) gives an error signal.

006) Gas heater alarm

The input for the error of the gas heater (input 14) is, or has been, in the 'off' state for minimum 3 seconds. This means the gas heater gives an error signal.

007) Fire suppression

The input for fire suppression (input 15) is, or has been, in the 'off' state. This means the fire suppression contact is activated.

008) Overheating switch

The input for the overheating switches (input 9) is, or has been, in the 'off' state while the heater was switched on. This means that (one of) the overheating switch(es) is activated.

010) Rotation sensor time-out

While the drum was running, the rotation sensor didn't go from the 'on' to the 'off' state for a too long time. This can mean the drum is jammed or the drum motor isn't working properly.

011) No air pressure

The input for the air pressure switch (input 8) is, or has been, in the 'off' state. This means the air pressure isn't sufficient.

012) Lint filter door opened

The input to detect if the lint filter door or drawer is closed (input 2) is, or has been, in the 'off' state. This means that the lint filter door or drawer has been opened.

013) Door opened

The input to detect if the door is closed (input 1) has been in the 'off' state while it should be in the 'on' state. The controller checks if the door is closed when a program is started and when a program is running. If, in this case, the door is opened, this message will be displayed.

014) Air flow sensor error

The input which monitors air flow (input 3) is not detecting the expected signal. When the machine is started the input should be in the 'off' state. After the blower is started the input should change to the 'on' state in the time defined in machine parameter 33. If the input is in the 'on' state when starting up, or does not go to the 'on' state in time then no air flow is detected. As this situation can be dangerous the machine is stopped.

Please note that if a dryer is stopped and then restarted quickly this message can appear without. Because of the inertia of the blower motor air will still be flowing, and the switch will stay in the 'on' state, for a short time after the blower motor has been stopped. If the machine is started again in during this period this message will also be given.

Also please note that if the lint filter door or drawer is opened when a program is running the air flow will change which can also cause the switch to open. In this case an additional 'air flow sensor error' will be given.

16) Temperature sensor 1 error

The cable of temperature sensor 1 is broken or there is a short circuit. The controller detects that the sensor is not properly connected.

17) Temperature sensor 2 error

The cable of temperature sensor 2 is broken or there is a short circuit. The controller detects that the sensor is not properly connected.

18) Error power supply

The 24V power supply is too low (below 20 Volts) or too high (above 40 Volts). Because this can cause damage to the controller, it has switched all outputs off. The actual power supply voltage can be checked at any time from the test program menu (see chapter 6.5.4).

19) Battery empty

When starting up the controller checks if the battery backed-up memory is still ok. If not, this message will be displayed. This message will only be displayed after start-up. The battery capacity is enough for 1 year, so it is strongly recommended to replace the battery every year (see chapter 2.4). The START button must be pushed to reset the message.

20) Microprocessor restarted

The dryer controller is able to monitor its power supply. If the power supply voltage is too low, or too high, alarm 18 will be displayed. If the power supply voltage is too low for the controller to be able to operate the microprocessor will reset itself. This can happen in case of a sudden, brief voltage drop. If this happens the microprocessor will memorize this and the next time the controller starts up, alarm 20 will be shown on the display.

25) Clean filter

The dryer controller will monitor input 16 to check if the filter needs to be cleaned (see chapter 2.3.1, input 16). If the controller detects that the filter needs to be cleaned this message will be displayed. This message is automatically removed when the filter is clean again or when the machine is stopped.

31) Delayed start in:

Delayed start has been adjusted and the timer for the delayed start is counting down to 0. At the moment the counter reaches 0, the machine will automatically start (see chapter 6.2)

34) Maintenance request

The maintenance request counter is 0 and the machine needs maintenance. The number of batches which can be done between 2 maintenance requests is adjustable with machine parameter 5). Resetting the maintenance request can be done via the 'System Setup' menu (see chapter 6.6.4).

36) Waiting for cycle restart

While a program was running the machine was stopped, either by an alarm or by pushing the stop button. If the start button is pushed the machine will continue its cycle. If the stop button is pushed the program cycle will be stopped.

37) Program finished

A program is finished. If the door is opened the machine will finish and start from the beginning again.

38) Ready to start

The machine is ready to start a new program. If the start button is pushed, and all inputs are okay, a program cycle will start.

8) Default settings and default programs

When the M720 controller is delivered, or when factory settings are recalled (see chapter 6.6.3), default programs and default machine parameters will be available.

8.1) Default program settings and default programs

Because the used language can vary, no default program names are set, except for program 50, which will be called 'Single cycle'.

All programs are set to the following default values:

01	Drying method	TIME
02	Material type	???? (Unknown)
06	Drying time	40 m
07	Dry temperature	167 °F / 75 °C
10	Cooldown time	10 m
11	Cooldown temp.	95 °F / 35 °C
13	Drum direction	REV
14	Drum speed	100 %
15	Drum stop time	1 s
16	Drum run time	45 s
19	Anti crease funct.	YES
22	Max. temp. rise	0 °/m
23	Max. temp. fall	0 °/m

In the default programs, some parameter values are set to a different value to provide different programs to start with. The following default programs are available:

Program	Drying time	Drying temperature
1	40	167 °F / 75 °C
2	30	140 °F / 60 °C
3	30	113 °F / 45 °C
4	40	140 °F / 60 °C
5	25	122 °F / 50 °C
6	25	113 °F / 45 °C
7	25	104 °F / 40 °C
8	20	104 °F / 40 °C
9	0	-
10	50	194 °F / 90 °C
50	20	140 °F / 60 °C

8.2) Default machine parameter settings

The default machine parameter settings are:

01	Tmp in Fahrenheit	NO
05	Maintenance cycl	0
06	Finished beeptim.	5 s
07	Overview status	0
11	RS485 stationnr.	1
12	RS485 baudrate	0
16	Cnt.reset no pass	YES
20	Use coin box	NO
21	Coin box 1 time	0 m
22	Coin box 2 time	0 m
26	Rotation time-out	10 s
27	Jog drum speed	25 %
30	Heater reset time	3 s
31	Blower clean time	5 s
32	Blower WYE del.	10 s
33	Del. check airflow	10 s

9) Setting up a new controller

Controllers are delivered with battery, but in most cases the battery will not be placed into the holder. This is done to save battery energy when the controller is kept on stock.

Because the dryer was shipped without a battery installed the battery backed-up memory will be gone. This means that the program counters, counters per day, and the total counters will be 0.

Also the time and date settings will be lost (and set to a default value). Set the date and time to the correct value as described in chapter 6.6.1.

All machine configurations will be at the default value when the dryer is shipped. So, the machine configurations also have to be set according to the type of dryer and the available options.

The controller will start up in the default language, which is English. If necessary the desired interface language can be changed as described in chapter 6.6.2.