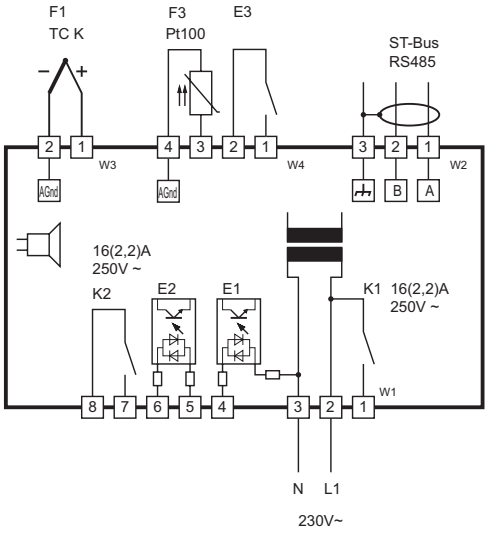
Deep-frying controller

Order number: 900430.064

As of: 08.11.2022 V1.12

Wiring diagram

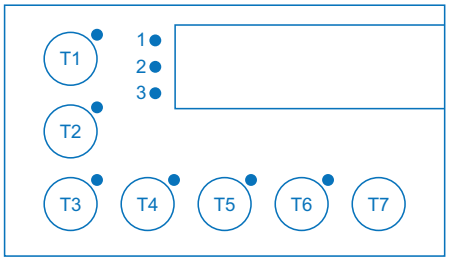


Product description

The ST522G controller fulfils the function of a temperature controller and is designed for use with deep fryers. It has a four-digit LED display, 7 keys, 2 contact outputs and 3 switching inputs. The temperature setpoint and the time settings can be parameterised directly via the keys.
The controller is networked by means of an ST-Bus interface..

Sensor:	Thermo couple, Pt100
Range:	dependant on type of sensor
Front size:	93 mm x 61 mm
Installation size:	125 x 72mm
Tightness:	Front IP65
Connectors:	Screw terminal

Displays



Function of the control buttons

Key T1: UP - Temperature
Pressing this key increases the parameter or parameter value.

Key T2: DOWN - Temperature
Pressing this key decreases the parameter or parameter value. In the event of an alarm, the buzzer is switched off by pressing the key.

Key T3...T5: Timer 1...3
Start/stop of sequence timer 1 ... 3
Pressing the key starts the timer. Pressing it again resets it. To set the timer, the key must be pressed for longer than 4 seconds (until the display flashes). The value is changed by pressing the UP or DOWN key alone. The new value must be accepted by pressing the timer key again.
The respective LED lights up when the active timer is selected and when the timer is changed.
The LED flashes at the end of the timer until confirmation with the timer key..

Key T6: SET
Display/adjust the selected setpoint or parameter.

Key T7: Standby
Off: Control deactivated
On: Control activated, measured value display.

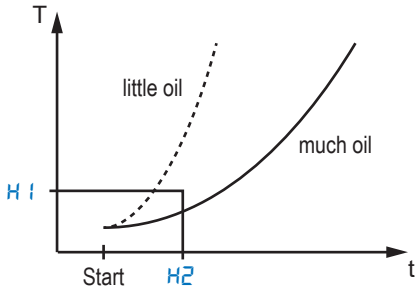
Oil shortage test

1. Temperature increase
If heat is supplied to a body, its temperature increases in proportion to the heat by the value ΔT

Q = M * ΔT Q: heat supplied.
(M = m * c is the thermal mass of the body).

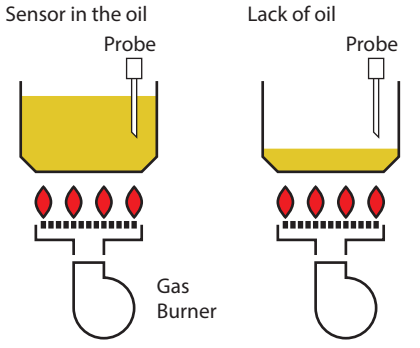
Q = m * c * ΔT m: mass of the body
c: specific heat

It therefore takes longer to heat up a large quantity of oil than a small quantity.
Conversely, the rate of increase in temperature can be used to draw conclusions about the quantity of oil present.



Temperature rise depending on the amount of oil

2. Thermal contact
For temperature measurement, the sensor must be in thermal contact with the medium. In deep fryers, however, it can happen that the sensor loses the thermal contact if it no longer protrudes into the oil due to a lack of oil (see illustration).
The measured value then no longer corresponds to the oil temperature, but to the ambient temperature at the sensor.



If there is a lack of oil, the sensor may lose thermal contact.

3. Little oil
If there is little oil left in the fryer, there is a fire hazard due to overheating of the oil. Temperatures higher than 230˚C are a fire hazard for most oils and fats.

3.1 Initial switching on of the heating
After switching on the controller, a test sequence starts once to check for lack of oil.
The controller heats for a predefined time and monitors the temperature rise.
A very fast rise is an indication of low oil (parameters H1 and H2).
The controller then switches off the heating and triggers an alarm message.
If, however, there is almost no temperature rise at all, this is again an indication that the sensor has lost thermal contact due to a lack of oil (parameters H3 and H4).
The controller then also switches off the heating and triggers an alarm message.

In the special case that the temperature is already high when switching on, it can be assumed that the fryer was in operation before. There is probably enough oil and the sensor is also in contact with the oil.
To avoid pseudo errors, the test sequence is then not executed. Parameter H5 sets a temperature threshold above which testing is not performed.

3.2 During operation
During operation of a deep fryer, it is only possible to conclude from the curve progression of the temperature that there is a lack of oil in special cases.

Setpoints

Pressing the SET key displays the setpoint S1.
Additional pressing of the UP or DOWN key changes the value. It is automatically saved after all keys are released.

Sequence timer

Pressing the timer key will show, start or stop the respective timer.

Control parameters

By pressing the UP and DOWN keys together for 3 seconds, the message "PA" appears in the display. After entering the password "-19" (with the SET and DOWN keys), you enter the parameter list for setting the control parameters.

The UP key scrolls up the list, the DOWN key scrolls down.
By pressing the SET key, the value of the selected parameter appears in the display; by pressing the UP or DOWN key again, the value is changed. It is automatically saved after the keys are released.

Setpoint level:

Para-meter	Description of function	Setting range	Default value	
Temperature setpoints				
S1	Temperature setpoint	P4 ... P5	100 °C	
Timer setpoints				
T1	Timer 1:	0:00 ... 59:59 Min.	1:11 Min.	
T2	Timer 2:	0:00 ... 59:59 Min.	2:12 Min.	
T3	Timer 3:	0:00 ... 59:59 Min.	3:13 Min.	

Control parameters:

Para-meter	Description of function	Setting range	Default value	Cust. value
General control parameters				
P 1	Delta W control circuit 2	-99...+99.0 K	10.0 K	
P2	Hysteresis control circuit 1	0.1...99.0 K	1.0 K	
P3	Hysteresis control circuit 2	0.1...99.0 K	1.0 K	
P4	Bottom setpoint limitation	0...999 °C	0 °C	
P5	Top setpoint limitation	0...999 °C	999 °C	
P6	Correction actual value 1	-20.0...+20.0 K	0.0 K	
P7	Display actual value 1	-	-	
PID parameter				
P 11	Control circuit 1: Proportional range in PID control	0.1...999 K	10.0 K	
P 12	Control circuit 1: Integral time in PID control (I portion)	0...999 sec. (0 sec. = inactive)	500 sec.	
P 13	Circuit. 1: Derivative action time in PID control (D portion)	0...999 sec. (0 sec. = inactive)	120 sec.	
P 14	Control circuit 1: Cycle time in PID control	2...100 sec.	20 sec.	
P 17	Behaviour of the MELT/TURBO LED (if available)	0: on during MELT 1: on during TURBO	0	
Relay delay				
P 18	Switch-off delay for heating relay	0.0...99.0 sec.	0.0 sec.	
Key lock				
P 19	Key lock (Setpoint adjustment disabled)	0: Not locked 1: Locked	0	
Alarm parameters				
P21	Lower alarm limit	-99...999 °C/K	-99 K	
P22	Upper alarm limit	-99...999 °C/K	200 K	
P23	Hysteresis alarm, one side	0.1...99.9 K	1.0 K	
P24	Alarm function	0: Alarm limit relative 1: Alarm limit absolute	1	
P25	Special function in case of alarm	0: Not active 1: Display flashing, buzzer active	0	
P26	Alarm suppression after Mains On	0...60 min.	0	
P27	Buzzer duration when timer elapsed	0...60 sec. (0 sec. = inactive)	5 sec.	
Display parameters				
P31	Display mode basic level	0: Integral numbers 1: Resolution 0.5 K 2: Resolution 0.1 K	0	
P32	Type of temperature display	0: Actual value display 1: Setpoint display	0	

Parameter	Description of function	Setting range	Default value	Cust. value
P34	Temperature scale	0: Fahrenheit 1: Celsius	1	
P36	Display in case of standby off	0: AUS 1: OFF 2: right decimal point	0	
P37	Display duration of timer 1/2/3 after pressing the button until it switches back to temperature display	1.0 .... 60.0 sec.	10 sec.	
Key parameters				
P41	Standby function	0: Not active 1: Standby with button click	1	
P42	Internal buzzer mode	0 ... 15 (0 = buzzer inactive) Bit mask (add values): +1: Button klick +2: Baking end +4: Error, high temperature/sensor error +8: Errors like an alarm relay	15	
P43	Delay of Start/Stop key at Standby-On	0.1...5.0 sec.	1.0 sec.	
P48	Key delay for MELT/TURBO key (if available)	0.1 ... 5.0 sec.	0.5 sec.	
Input and output parameters				
P51	Function of external input E1 (switching sense see HS1)	0: No function 1: Message overtemperature „hot“ 2: Message burner error „burn“ 3: Message „OPEn“ 4: Message „EL.UP“	0	
P52	Function of external input E2 (switching sense see HS2)	see P51	0	
P53	Function of external input E3 (switching sense see HS3)	see P51	0	
P54	Assignment output K1	0: Not active 1: Control circuit 1 2: Control circuit 2 3: on, if controller on	1	
P55	Assignment output K2	see P54	2	
P58	Tolerance time for burner start and restart chance	1...20 sec.	10 sec.	
Fryer parameters				
P71	On time of heating clocking	1...255 sec.	50 sec.	
P72	Off time of heating clocking	1...255 sec.	30 sec.	
P73	Clock end below threshold	-99...0,0 K	-30 K	
P77	Selection of post-frying time	0: Fixed time 1...20: Elastic time	0	
P78	Activation of heating clocking	0: Not active, always turbo heating 1: Gentle heating	1	
P79	Threshold for return to heating clocking mode	0.0...99.0 °C	50.0 °C	
Operating time parameters				
P81	Temperature limit for fat operating time elapsed	0.0...999 °C	999 °C	
P82	Fat operating time until warning message	0...99 hrs. (0 hrs. = inactive)	50 hrs.	
P83	Fat operating time until controller block	0...99 hrs. (0 hrs. = inactive)	0 hrs.	
P84	Display of fat operating time	-	-	
P85	Temperature limit for reset of fat operating time (only effective if P86 = 2)	-99...999 °C	100 °C	
P86	Reset option of fat operating time	0: No restrictions 1: After warning message or blocking 2: After warning message or blocking plus cool-down	2	

Parameter	Description of function	Setting range	Default value	Cust. value
Sensor and hardware parameters (if changed, Mains Off required)				
P91	Selection of sensor type	0: Pt100 2-wire 1: Thermocouple type J (Fe-CuNi) 2: Thermocouple type K (NiCr-Ni)	2	
P92	Display compensation	-	-	
P93	Software filter depth	1...64	8	
P94	Mains frequency	0: 50 Hz 1: 60 Hz	0	
LowFat and NoContact settings				
H1	Lack of oil: max. permitted temperature rise	0.1...99.0 K	1.0 K	
H2	Lack of oil: duration of the test	0...240 sec. (0 sec. = inactive)	0 sec.	
H3	Lack of oil: Max. permitted duration for the increase	0...240 sec. (0 sec. = inactive)	0 sec.	
H4	Lack of oil: Temperature increase	0.1...99.0 K	1.0 K	
H5	Max. temperature for “lack of oil” monitoring	1...990 °C	60 °C	
H51	Input E1: switching sense	0: 230V applied: OK 1: 230V applied: Error message	0	
H52	Input E2: switching sense	0: 230V applied: OK 1: 230V applied: Error message	0	
H53	Input E3: switching sense	0: Input closed: OK 1: Input closed: Error message	0	
H55	Minimum On-Time burner	0...99 sec.	0 sec.	
H56	Minimum Off-Time burner	0...99 sec.	0 sec.	
H62	Control characteristic	0: 2-point thermostat 1: PID	1	
Address + version				
Lo	Controller address	1...255	5	
Pro	Program version	—		

All the following parameters can only be reached via the ST-Bus with a gateway!

Parameter	Description of function	Setting range	Default value	Cust. value
b 1	Key for UP (PLUS)	1 ... 7 (0 = inactive)	1	
b 2	Key for DOWN (MINUS)	1 ... 7 (0 = inactive)	2	
b 3	Key for SET	1 ... 7 (0 = inactive)	6	
b 4	Key for MELT/TURBO	1 ... 7 (0 = inactive)	0	
b 5	Key for STANDBY	1 ... 7 (0 = inactive)	7	
b 6	Key for TIMER 1	1 ... 7 (0 = inactive)	3	
b 7	Key for Timer 2	1 ... 7 (0 = inactive)	4	
b 8	Key sound: Mask when ON	0 ... 127	124	
b 9	Key sound: Mask for Standby	0 ... 127	92	
b10	Key for Timer 3	1 ... 7 (0 = inactive)	5	
b32	Mode for SET function	0: 2-button operation (SET+UP/DOWN) 1: 1-button operation (UP/DOWN only)	0	
b33	Time until SET active	Time until key lock deactivated (b32=1)	0.0 sec.	
b34	Time until setpoint is accepted	Time until value is accepted (b32=1)	0.5 sec.	

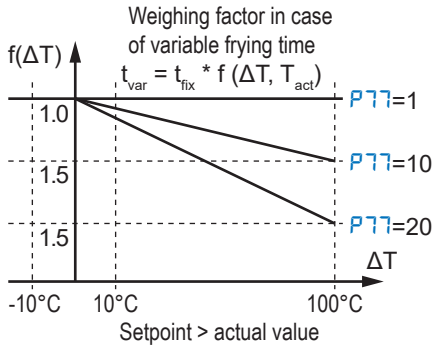
Para-meter	Description of function	Setting range	Default value	Cust. value
u11	LED 1	0: - 1: Heating 2: Cooling ON 3: Melt/Turbo 4: PID 5: Timer 1 6: Timer 2 7: Timer 3 8: Input E1 9: Input E2 10: Input E3	1	
u12	LED 2	see u11	0	
u13	LED 3	see u11	0	
u14	LED 4	see u11	0	
u15	LED 5	see u11	0	
u16	LED 6	see u11	0	
u20	LED week timer	0: - 1: weekdays 2: individual after u21 ... u27	2	
u21	LED Mo	see u11	0	
u22	LED Di	see u11	0	
u23	LED Mi	see u11	0	
u24	LED Do	see u11	0	
u25	LED Fr	see u11	0	
u26	LED Sa	see u11	0	
u27	LED So	see u11	0	
u31	LED key 1	see u11	0	
u32	LED key 2	see u11	0	
u33	LED key 3	see u11	5	
u34	LED key 4	see u11	6	
u35	LED key 5	see u11	7	
u36	LED key 6	see u11	0	
P99	Password level P - -	-99 .. +999	0	
H99	Password level H - -	-99 .. +999	0	
b99	Password level b - -	-99 .. +999	0	
L99	Password level L - -	-99 .. +999	0	
q99	Password level q - -	-99 .. +999	0	
PW	Password level PA	-99 .. +999	-19	

Note: Q parameters for touch keys!
These parameters are also only visible via the ST bus! An incorrect setting can cause the keys to become “unusable” and you lock yourself out!

The parameters should not be adjusted.

Selection parameter post-frying time

With parameter P77, you can define if the frying time is exactly the programmed time or if the frying time is to be extended if the fried material causes a temperature decrease.
Extension of the frying time, also referred to as elastic time or post-frying time, depends on the deviation from the setpoint. If the setpoint is exceeded, the time is reduced.



Setpoint 180 °C, selected frying time 100 s

Act. value	P77	Effective frying time
180 °C	0	100 sec.
150 °C	0	100 sec.
180 °C	1	100 sec.
150 °C	1	120 sec.
180 °C	10	100 sec.
150 °C	10	135 sec.
180 °C	20	100 sec.
150 °C	20	150 sec.
125 °C	20	210 sec.
100 °C	20	300 sec.

Heating feedback

(P51...P53 = 2)
In the case of heating, the participation of a feedback from the burner control unit is possible, which is defined via a switching input. The feedback confirms that the burner has started properly and otherwise causes the control to be aborted. The feedback can be adjusted in the switching direction by the parameters H51 ... H53.

The control at the heating output only takes place if the feedback is present at the parameterised switching input. Without feedback, the heating relay is therefore not switched on and, conversely, also switched off again if the feedback no longer exists during heating.

Heating mode „Gas+Fan“:

Restart when the control is switched off:
The control at the heating output is first switched on when requested by the control section, then it waits for the feedback to arrive for the time specified in parameter P58. If the feedback is received at the parameterised switching input or if it is already present at the time of the request, control is continued. If the feedback is not received, the control is switched off. The error message “burn” is displayed. To acknowledge and restart the control, press the “Standby” key, i.e. switch to standby off and on again.

Burner failure with restart chance:
If the feedback fails during control, the system waits for the burner to restart and the feedback to return for the time specified in parameter P58. If the feedback returns, control continues normally. If the feedback does not return, the control is switched off.
To acknowledge and restart the control, press the “Standby” key again, i.e. switch to standby off and on again.

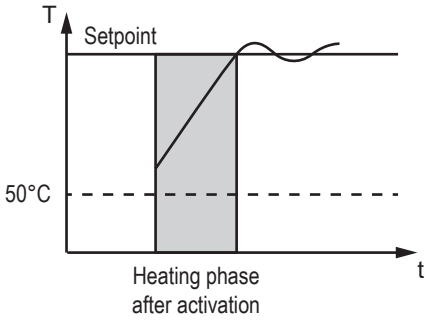
Deactivation of the feedback:
If the respective parameter P51 ... P53 is set to 0, the feedback function is deactivated.

The control function of the fryer controller is explained below and is always valid when the controller is switched on.

Control function

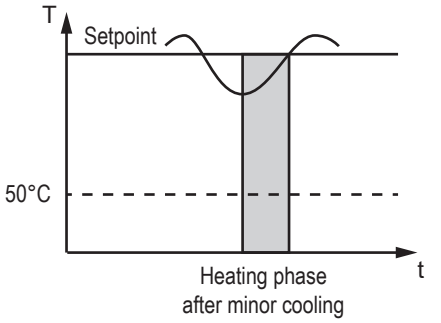
Heating phase without manual intervention:

Heating phase after activation:



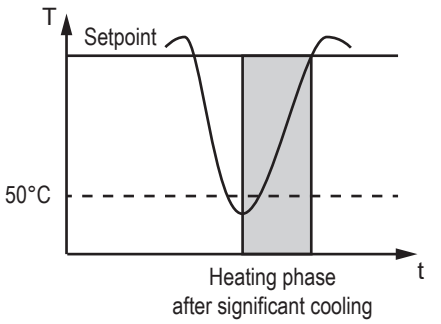
After activation and start of the controller, a slow heating phase will always follow when the fat is cold. This phase ends at latest when the setpoint is reached. In this slow heating phase, the heating relay clocks, i.e. with the on time set in parameter P71 being followed by the off time set in parameter P72. Slow heating is to ensure that congealed fat is heated up gently at the start of operation. Via parameter P73, you can stop the slow heating phase before the setpoint is reached. If this is not desired, set P73=0.0 K.

Heating phase after slight cooling:



After a minor cooling down to temperatures above 50 °C, e.g. by loading small amounts of cold fat, the normal heating function of the controller is maintained. The reheating phase is therefore not slowed down; if the thermostat function is set via the parameterisation, the heating relay does not cycle. If the PID function is preset, the heating relay only cycles within this range. The end of the cycle set with P73 has no effect.

Heating phase after significant cooling:



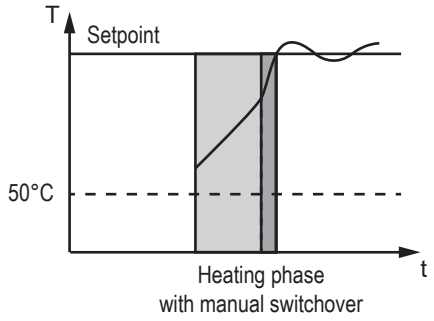
After significant cooling to temperatures below 50 °C, e.g. loading of large quantities of cold fat, the slow heating function is activated again. The heating relay cycles again like in the initial heating phase, until the setpoint or the cycle end below the setpoint defined in parameter P73 is reached again. This is to ensure gentle heating of the reloaded fat.

Control after heating
After the heating phase, the controller works with the PID function based on parameter group P11 to P14.

ATTENTION: The following functionality is only available if a key is parameterised for the function “MELT/TURBO”.

Heating phase with manual intervention:

Heating phase after activation.



After activation and start, the slow heating phase will start without manual intervention. By pressing the quick heating button MELT/TURBO, you can switch over to the normal heating function. Now, the fat will be heated more quickly. The heating relay will no longer cycle based on the times set in parameters P71 and P72 but based on the PID function set via the PID parameters. The cycle end defined via parameter P73 does not have any influence after the manual intervention.
To undo the switch-over, press the MELT/TURBO button again. Now, the heating relay will cycle like before the manual change-over again.

The manual change-over function can be used for reducing the heating phase if the fat has melted visibly and can be heated at a higher rate without any damage. Manual change-over between slow heating and turbo heating is possible only if the controller actually is in the heating phase, i.e. below the threshold set via parameter P73. Above this threshold, the turbo button has no function.

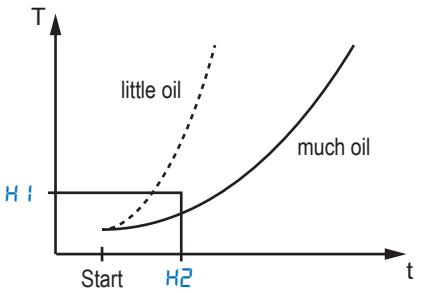
Heating phase after significant cooling
After significant cooling to temperatures below 50 °C, e.g. loading of large quantities of cold fat, a slow heating phase will start, although the change-over to normal heating mode is effected earlier; the heating relay clocks like in the initial heating phase.
Thus, manual change-over to normal heating function is only effective for the current heating phase and will become ineffective as soon as the setpoint is reached, at the latest. After that, as well as after mains failure and restart, the controller is in normal operation mode with slow heating phase when the controller is switched on and started or restarted later or in the case of cool-down to temperatures below 50 °C.
The switch-back threshold is can be set via parameter P79.

Switch-off delay for heating relay:
With parameter P18, you can define a switch-off delay for the heating relay which is effective in all operation modes. The parameter is provided for cases, where the ignition of the gas heating is always delayed. In the operating modes “Gas+Fan”, the PWM signal for the fan is maintained for the duration of the delay until the fan run-on also takes place after the heating is switched off.

Caution: The setting P18 must be done taking utmost care, as it is active independent of the control part. For this reason, short cycle times might result in unintended permanent heating.

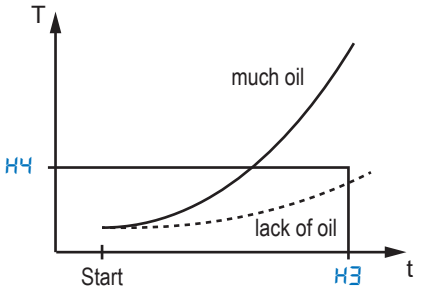
LowFat- and NoContact control setting

H1 Lack of oil: max. permissible temperature rise
H2 Lack of oil: duration of the test
After switching on, the controller checks once whether there is enough oil.
To do this, it switches on the heating and monitors the temperature rise.
The less oil there is, the faster the temperature rises:



After time H2, the temperature should not have risen more than H1, otherwise the controller triggers an alarm message and blocks the heating.

H3 Lack of oil: maximum allowed duration for temperature rise
H4 Lack of oil: temperature rise
After switching on, the controller checks once whether there is enough oil.
To do this, it switches on the heating and monitors the temperature rise.
If the temperature sensor no longer has thermal contact with the oil due to a lack of oil, the sensor will only see a slight or no temperature rise despite the heating:



After the time H3, at least the rise H4 should have occurred, otherwise the controller triggers an alarm message and blocks the heating.

H5 Temperature limit for checking lack of oil
If the temperature is already high when you switch on, this indicates that there is some oil present. It is likely that heating has also taken place beforehand. In any case, the sensor is also in thermal contact with the oil. Parameter H5 defines the temperature limit above which no monitoring takes place.

H51 Input E1: switching sense
H52 Input E2: switching sense
Definition, if the switching input at 230V corresponds to an OK signal or an error signal.

H53 Input E3: switching sense
Definition if the switching input corresponds to an OK signal or an error signal as a normally open contact.

H55 Minimum ON-time burner
H56 Minimum OFF-time burner
A gas burner needs a minimum time to ignite the flame.
Therefore, it does not make sense to switch it on or off for short periods.

A PID controller, on the other hand, can also request low outputs. The controller then rounds up or down to the minimum times.

H62 Control characteristic
A PID controller can regulate the temperature much more precisely, but for this it generally needs many more switching cycles than a thermostat (consider the service life of the relays).

L0 ST-Bus, own address
L1 ST-Bus, address of an assigned slave
L2 ST-Bus, mode Master/Slave
L3 ST-Bus, Index
These parameters are reserved for a network with ST-Bus.

J1: active data set
This parameter is intended to set certain predefined data sets. The data sets are predefined by Störk-Tronic. If a new data set is imported, all previously set parameters are overwritten. They can then be freely changed.

Pro **Software-Version**

Status messages

Indication	Cause	Note
F1	Error sensor F1 (thermocouple)	Sensor break (in the case of thermocouples, a short circuit cannot be distinguished from a valid signal)
F2	Error sensor F2 (Sensor for terminal temperature)	Internal sensor defective
F3	Error sensor F3 (Pt100)	Check Pt100
Actual value flashing	Limit value alarm when ON	-
Hot	Overtemperature, signalled by a switching input	Allow to cool down and switch the controller off and on again with the OFF button.
burn	Burner error, signalled by a switching input	Eliminate error and switch off and on with the Standby button
FAt	Alarm of the LowFat- or NoContact control mimic	Check oil level and switch off/on with Standby button
EP	Error in parameter memory	Repair the controller
EPS	Error of the touch keys	Repair the controller
OIL Control running	Warning message because the fat operating time for this has been exceeded (see P82)	Acknowledge with the DOWN key
OIL Control blocked	Control blocking because the fat operating time for this has been exceeded (see P83)	Acknowledge with the MELT plus START button (note P86)
rES	The grease operating time has been reset (see P86)	—
E1 (alternating with actual value)	Error message at input E1 (burner reports missing flame)	See parameter H50 The controller goes into standby and switches off the burner. A reset is required to switch on again.
E2 (alternating with actual value)	Alarm message at input E2 (External temperature limiter has triggered)	See parameter H51 The controller goes into standby and switches off the burner. A reset is required to switch on again (also temperature limiter).
E3 (alternating with actual value)	Alarm message at input E3	
„---“ flashing	Key lock (P19=1)	—

Analogue inputs	**F1:**	Temperature sensor thermocouple TC Type J or K
	F2:	Internal sensor, temperature of terminal point, PTC with characteristic curve for KTY81-121
	F3:	Temperature sensor Pt100 or thermocouple TC Measuring range: Pt100 -50...+350 °C TC -50...+350 °C
	Measuring accuracy referred to controller at 25 C: +/-1 K and +/-0.5 % of measuring range	
Digital inputs	**E1:**	Input for 230V~ voltage — Function see parameter PS 1/HS 1
	E2:	Input for 230V~ voltage — Function see parameter PS2/HS2
	E3:	Input for potential-free contact — Function see parameter PS3/HS3
Switching outputs	**K1:**	Relay, 12(2) A / 250 V~ — Function see parameter PS4
	K2:	Relay, 12(2) A / 250 V~ — Function see parameter PS5
	Buzzer, approx. 80dB	
Power supply	230V~ 50/60 Hz, power consumption approx. 3W	
Connectors	**W1:**	Screw/plug-in terminal, 6-pole, grid 5.08mm, for cables up to 2.5mm².
	X1:	Screw-/plug-in terminal, 2-pole, grid 5.08mm, for cables up to 2.5mm².
	W2:	Screw/plug-in terminal, 3-pole, grid 3.5mm, for cables up to 1.5mm².
	W3:	Spring clamp terminal, 2-pole, grid 5.0mm, for cables up to 2.5mm².
	W4:	Screw/plug-in terminal, 4-pole, grid 3.5mm, for cable up to 1.5mm²
Ambient conditions	Storage temperature	-20...+70 °C
	Operating temperature	0...55 °C
	Relative humidity	max. 75 % r.H., no condensation
Enclosure type	IP65 front, IP00 rear	
Protection class	Protection class II, rated voltage 250 V~	
Interface	**ST-Bus** 57600 baud, interface driver RS485, galvanically not isolated. For STP cable (shielded 2-wire cable), maximum cable length 1000m.	
Installation data	The display unit is designed for installation in a switching panel (note dimensioned drawing). Front size: 93 mm x 61 mm Assembly size: 125 mm x 72 mm