

# RoboLabs

Incredible machines for fastfood & funfood

## Popcorn machine

### VPM-RM4

## Instruction Manual



Original instructions. Read this document before use and keep it for future reference. PDF version is available on [www.robolabs.pro](http://www.robolabs.pro)

# Contents

1 Safety requirements.....	3
2 General information.....	4
2.1 Designation.....	4
2.2 Technical specifications.....	4
2.3 Delivery set.....	4
2.4 Packing.....	4
2.5 Transporting and storage.....	4
2.6 Design and principle of operation.....	5
2.7 Stages of operation.....	7
2.7.1 Standby mode.....	7
2.7.2 Heating stage.....	7
2.7.3 Popping stage.....	8
2.7.4 Pause stage.....	8
2.7.5 Cooling stage.....	8
3 Commissioning.....	9
3.1 Ambient requirements.....	9
3.2 Installation.....	9
3.3 Electric requirements.....	10
3.4 First start (operation check).....	10
4 Intended use.....	11
4.1 Operating order.....	11
4.2 Status and error messages.....	13
4.3 Chamber clogging.....	14
4.4 Notes on using oil and salt.....	15
4.5 Abnormal operation.....	15
5 HMI interface.....	16
5.1 Start screen.....	16
5.2 Program settings screen.....	16
5.3 Operation screen.....	17
5.4 Temp graph screen.....	17
5.5 General settings screen.....	18
5.6 Testing screen.....	20
6 Cleaning.....	22
6.1 Daily cleaning.....	22
6.2 Weekly cleaning.....	23
7 Technical service.....	24
7.1 Technical maintenance.....	24
7.1.1 Technical maintenance Stage 1 schedule.....	24
7.1.2 Technical maintenance Stage 2 schedule.....	25
7.2 Lamp replacing.....	26
7.3 Electric panels layout.....	27
7.4 VFD unit.....	28
7.5 Fiber amplifier.....	30
7.6 Thermal cut-out.....	31
7.7 Stepper drivers.....	32
7.8 Photoelectric sensor.....	33
7.9 Supply cord replacing.....	33
7.10 Troubleshooting.....	34

7.10.1 Machine does not turn on.....	34
7.10.2 Machine does not turn off.....	34
7.10.3 Chamber lamp does not work.....	34
7.10.4 No heating, not enough or unstable heating.....	35
7.10.5 ‘temperature sensor failure’ error.....	35
7.10.6 False chamber clogged.....	35
7.10.7 Corn auger does not work.....	36
7.10.8 False reading on corn bin empty/full.....	36
7.10.9 Turbine does not spin, ‘Turbine Motor Failure’ error.....	36
7.10.10 Sifter does not spin.....	36
7.10.11 Sifter does not stop once SIFTER pressed.....	37
7.10.12 Oil is not pumped.....	37
7.10.13 Salt auger does not rotate.....	37
7.10.14 Salt blower does not work.....	37
7.10.15 Oil cabinet is not heated.....	38
7.10.16 No sound alarm.....	38
7.10.17 Circuit breaker trips.....	38

This document (hereinafter — the manual) contains essential information on installation, intended use, and technical maintenance of popcorn machine VPM-RM4 (hereinafter — the machine).

The manual is intended for operators who work with the machine, and for technical personnel who conduct installation, commissioning, and technical service.

The manual must be kept during all life time of the machine in place readily available for operators, and technical personnel.

# 1 Safety requirements



This is the safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

## **DANGER**



- Not grounded machine can cause electric shock. Power outlet **MUST HAVE** proper grounding to avoid electric shock.
- **DO NOT** use excessive water or water jet for machine cleaning. **DO NOT** spill water on electric panels or parts. Using excessive water during cleaning can cause short circuit and electric shock.
- **DO NOT** immerse machine and/or supply cord into water.
- **ALWAYS** unplug machine before cleaning or servicing.
- No user serviceable parts inside. **DO NOT** open electric panel unless you are qualified for this.

## **WARNING**



- Touching might cause burn. **DO NOT** touch while in operation.

## **WARNING**



- **DO NOT** use machine in the way other than intended.
- **DO NOT** leave operating machine unattended.
- **DO NOT** modify design of the machine.

## **WARNING**



- **DO NOT** reach into working machine. Rotating drum can cause limb injury.

## **WARNING**



- Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury, or death. Read and understand this manual before use.
- Only instructed personnel is allowed to operate the machine.

## 2 General information

### 2.1 Designation

Popcorn machine VPM-RM4 (hereinafter — the machine) is intended to make popcorn. Commercial use only.

### 2.2 Technical specifications

Throughput <sup>1</sup>	up to 28 kg/h
Rated voltage	400 VAC
Rated current	27 A
Rated frequency	50 Hz
Dimensions (LxWxH), not more	147x61x170 cm
Weight, not more	250 kg
Design life	7 years

### 2.3 Delivery set

Machine assembled	1 pc
Oil pump	1 pc
Magnetic bracket	1 pc
Cart	2 pcs
Plastic bag	50 pcs
Measuring cup 2 L	1 pc
Cleaning brush	1 pc
Cleaning scraper	1 pc
Electric panel key	1 pc
Halogen lamp	1 pc
Documentation set	1 pc

### 2.4 Packing

The machine is supplied in packaging that protects the machine from mechanical impact and soil during transporting and storage.

### 2.5 Transporting and storage

The machine may be transported by any kind of covered vehicle, in accordance with transportation rules for this kind of vehicle. Ambient temperature during the transportation and storage must be between minus 25 °C and plus 55 °C.

---

1 Refers to corn seeds weight at the input of the machine, not output.

## 2.6 Design and principle of operation

Main components of the machine are shown on Fig. 1. Motor (13) with turbine (25) causes air circulation inside the machine. Air goes from the turbine to the working chamber (20), then to the heating elements area (24), where it is heated, and finally goes back to the turbine. In the low part of the working chamber there is perforated bowl (23), that has many holes of special shape, which cause air vortex inside the chamber as airflow goes through the bowl. Working chamber is closed with hatch (21), fixed with four latches (19).

Corn kernels are put in the corn bins (3) (4). Each bin is equipped with motor (18), level sensor (18), and an auger inside the bin. Motor drives the auger, rotating auger pushes corn kernels to the supply tube (15), which leads to the working chamber. In the chamber the kernels are heated up, and then eventually pop and exit to the sifter (11).

Crumb tray (2) collects small particles of popcorn being screened in the sifter. Level sensor (12) controls the level of popcorn collected in the cart (not shown).

Oil pump compartment (1) accommodates oil pump. Special salt is put in the salt bin (7) with an auger inside. Motor (9) drives the salt auger, which pushes the salt from the bin. Blower (8) blows the salt through removable salt supply tube (10) on popcorn inside the sifter.

Most electric components of the machine are accommodated in upper (6) and lower (14) electric panels. Upper panel includes control panel (5). START push button turns the machine on; SIFTER push button is used to stop sifter for short time during operation; OIL WARM switch turns on and off heating in the oil cabinet.

Emergency stop switch (17) turns the machine off at any moment.



Figure 1

Working chamber inside is shown on Fig. 2.

The perforated bowl (1) has many holes of special shape. Air flow from turbine goes from below and, due to that holes, creates air vortex inside the chamber (shown by an arrow).

Corn kernels come into the chamber from the supply tube (4). Due to the vortex, corn kernels are constantly moving around center of the perforated bowl.

Baffle (7) divides the chamber for the area where corn kernels are being heated up, and the output area.

Mesh screen (6) protects internal cavities (including heating elements area) from popcorn dust and scrap accumulation.

Temperature sensor (2) measures air temperature in the chamber.

Heat-resistant head (3) is a sensitive element that linked to a fiber amplifier located in the electric panel. This system controls corn movement inside the chamber. In case of corn is accumulated in large amount, which is not moving, the machine alarms the operator and stop corn feeding to avoid chamber clogging.

Chamber lamp (5) illuminates the chamber, so an operator can visually control the process through the observation port in the chamber door.

Sifter cabinet is shown on Fig. 3. Popped popcorn comes from the working chamber via opening (4). Sifter (1) has perforation that allows scrap to be screened to the crumb tray (5). Sifter lays on idle roller (2) and drive roller (7). Motor (6) drives the drive roller. Oil nozzle (3) is connected to the oil pump.

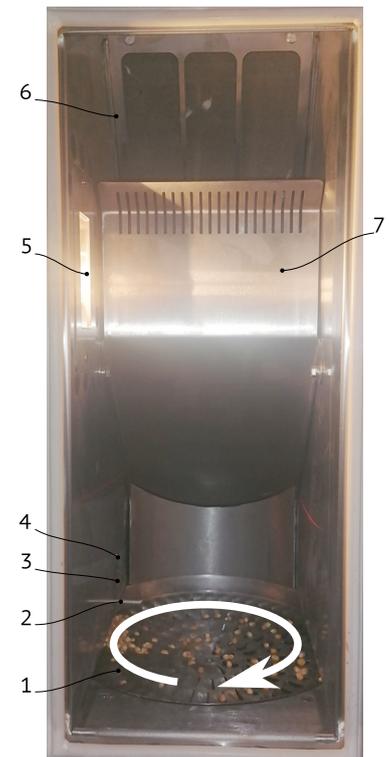


Figure 2

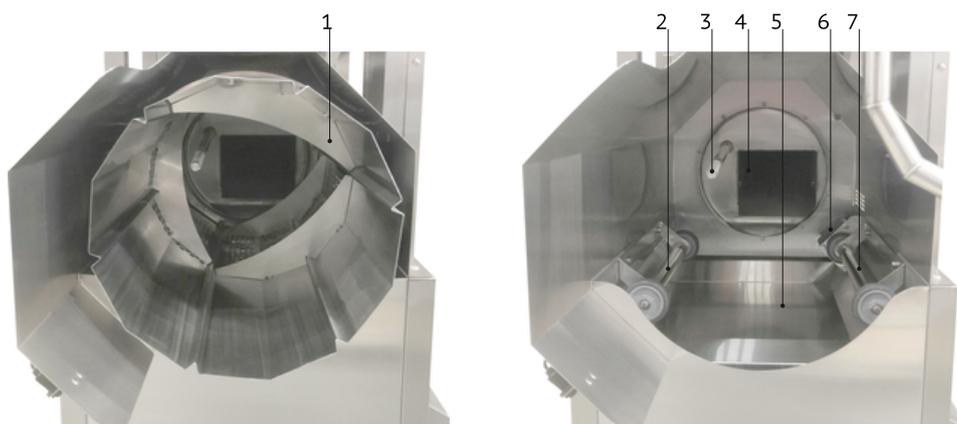


Figure 3

Oil pump cabinet is shown on Fig. 4. The oil pump has the Motor (8) that drives gear-type Pump Unit (2) that is immersed in oil canister. Cover (5) can be adjusted by height with the Fixing Screw (4) to fit oil canisters of different height. Oil goes through the Hose (3) that is connected via Quick-Release Connector (6), and then goes to the oil nozzle in the sifter cabinet. Magnetic Holder (10) allow to hand the pump in the cabinet. The motor is connected to Socket (9).

Sliding Shelf (1) is heated from below with heating elements; thus allowing constant temperature in the cabinet (when it is closed with doors). Doors are mounted to magnet locks (9).



Figure 4

## 2.7 Stages of operation

Whenever the machine is turned on, it is in one of the following stages of operation.

### 2.7.1 Standby mode

Once the machine is turned on, the HMI panel boots up, and the machine is waiting for operator action. At this moment operator can:

- Check and adjust parameters of the machine, and also reset settings to default.
- Test separate components of the machine.
- Start popcorn production process.

### 2.7.2 Heating stage

Once operator initiates the production process, the machine starts to heat up air in the chamber. Upon reaching the set value temperature the machine automatically starts popping stage.

### **2.7.3 Popping stage**

Machine processes corn kernels by continuous flow.

### **2.7.4 Pause stage**

Whenever the operator initiates pause, the machine stops corn feeding. The temperature in the chamber is maintained at the set value. Popping process can be resumed at any time.

### **2.7.5 Cooling stage**

The machine needs to be cooled down before turning the turbine off. Whenever the operator initiates cooling mode, heating elements are de-energized; but the turbine keeps running, cooling down the machine. Once temperature drops low enough, the turbine stops and the machine can be turned off.

## 3 Commissioning

### **DANGER**



- Not grounded machine can cause electric shock. Power outlet **MUST HAVE** proper grounding to avoid electric shock.
- Wall receptacle **MUST** be installed by a qualified electrician.
- If supply cord damaged, it **MUST** be replaced by manufacturer, service agent, or a skilled person in order to avoid hazard.
- **DO NOT** connect the machine to voltage inverters of any kind.

### **WARNING**



- Installation, assembling, and electric connections must be performed by a qualified technician.

### 3.1 Ambient requirements

This machine is designed to be operated indoors at the ambient temperature from +5 °C to +40 °C (+41 °F to +104 °F) and relative humidity not more than 45% at 40 °C (104 °F) while using at altitudes not exceeding 1000 m over the sea level. The temperature decreasing is related to RH increasing, for example, 90% of RH at 20 °C (68 °F). This machine **MUST NOT** be exposed to precipitations of any kind (rain, snow and so on).

A ventilation hood measuring at least 800x800 mm must be provided above the machine, with a minimum capacity of 750 cu.m/h.

### 3.2 Installation

1. Unpack the machine carefully and keep packaging for future use.
2. Check the delivery set.
3. Put the machine on a flat, even, clean surface.
4. Lock all four swivel casters.
5. Remove protective film where applicable.
6. Wipe all surfaces with a clean cloth dampened with a mild soap. Then remove soap residues with a cloth dampened with water. Let it dry.
7. Assemble popcorn carts from the delivery set.
8. Put oil pump inside the oil pump cabinet, connect the pump's hose to quick release connector and the pump cable to the corresponding socket (see Fig. 4).
9. Inspect the supply cord for any damages.

### 3.3 Electric requirements

The machine requires 3 phase 400 V 50 Hz five-wire system<sup>2</sup> (L1-L2-L3-N-GND). Use 3P+N+PE 32 A 400 V pin and sleeve connector (IEC 60309). Connecting to the mains must be arranged in conformity with all requirements applicable in the country of use at the moment of commissioning. The machine has a 3P 32 A circuit breaker with rated short-circuit capacity 6 kA at its input.

Equipotential bonding wire (up to 10 sq.mm) shall be connected to screw terminal on the base frame marked with IEC 60417-5021 sign: 

Check the voltage in the receptacle. Plug the machine in. Make sure that the supply cord is not twisted, pulled, and is not mechanically impacted in any other way; and also is not in contact with hot surfaces.

### 3.4 First start (operation check)

ATTENTION! Machine that was kept for a long time at temperatures below 0 °C must be kept in normal room temperature (20-22 °C) not less than 12 hours before first start.

Follow these steps to check the machine operation:

1. Release the Emergency stop switch (if actuated).
2. Press START push button.
3. Wait until HMI screen load complete.
4. Press and hold TURN OFF button on the screen for 1 second.
5. Unplug the machine.

---

<sup>2</sup> One phase is not used.

## 4 Intended use

### **DANGER**



- DO NOT use machine if supply cord, cable plug, or wall receptacle are damaged.
- DO NOT allow supply cord to be twisted, bent, pulled, contacted with sharp edges, or to be mechanically impacted in any other way.
- DO NOT let supply cord to be in contact with hot surfaces.

### **WARNING**



- DO NOT touch hot surfaces.
- Hot air comes out from corn supply tube. Stay clear.

### **WARNING**



- DO NOT reach into the corn bin and DO NOT touch rotating auger.
- DO NOT reach into rotating sifter.
- DO NOT wear dangling jewelry, loose clothing, rings or have loose, long hair that could get caught up by rotating drum.

### **WARNING**



- DO NOT turn off while in operation. Failed to do so will cause popcorn machine to be clogged with popcorn, which might cause smoke formation.
- DO NOT leave working machine unattended.
- DO NOT use machine in other way than intended.
- All four swivel casters **MUST** be locked whenever in operation. Unlocked casters might lead to accidental move of the machine.
- It is a **MUST** to provide free access, at any time, to wall receptacle, and switchboard to which the receptacle is connected.

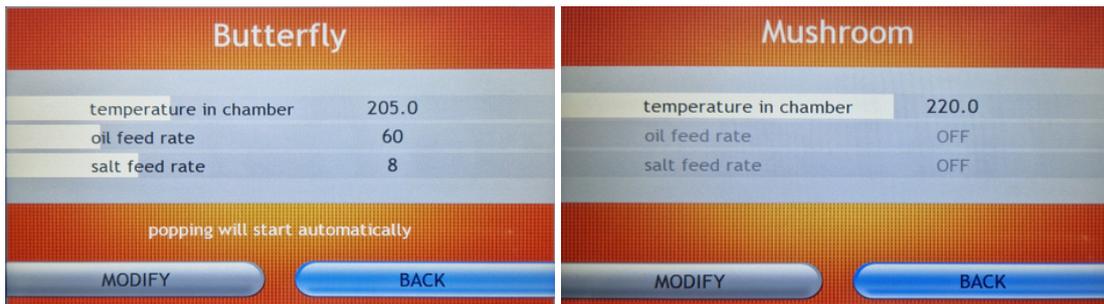
### 4.1 Operating order

1. Fill corn bins with corn kernels.
2. If you want to make popcorn with oil and salt, fill salt hopper with salt, open oil pump cabinet, put a container with liquid oil, immerse the oil pump in the container; close the cabinet with both doors. Set the OIL WARM switch to (I).
3. Prepare two popcorn carts with a plastic bag in each. Put one cart under the output port of the sifter.

4. Press START push button on the control panel. Wait until start screen appears:



5. Press BUTTERFLY or MUSHROOM button on the screen, program setting screen appears:



6. ATTENTION! If no button pressed, the machine will proceed to heating stage automatically in 15 seconds. After this moment you won't be able to change parameters until machine switches to popping mode.
7. If parameters need to be modified, press MODIFY button, type 2325 password, and then press ENTER.
8. Change the parameters as needed.
9. The machine starts heating up, HMI screen reads 'HEATING'.
10. Once heated up, machine automatically switches to popping mode, HMI screen reads 'POPPING':



11. Note that when Butterfly program is activated, oil and salt are turned on with a delay (see Settings section).

12. To replace full bag of popcorn DO NOT use PAUSE button on the screen. Press SIFTER push button under the screen. The sifter stops for 20 seconds, and then resumes rotation. In this time replace full cart with an empty one.
13. To put process on pause or to change the program press PAUSE button; wait until program buttons appear on the screen. To resume production, press desired program button.
14. To finish operation, press TURN OFF button. The machine switches to cooling mode, the display reads 'COOLING'. Note: when operated in Butterfly program, oil and salt will be turned off with a delay (see Settings section).
15. Wait until the start screen appears. Press and hold TURN OFF button to shut down the machine. Otherwise, if no button pressed, the machine will be turned off automatically in 10 minutes.

## 4.2 Status and error messages

During normal machine operation different notifications may be displayed on the screen. Below is the list and operator's actions suggested to be taken.

**Heating / Popping / Pause / Cooling** — Indicates current operation mode.

**Load corn in left (right) hopper** — Corn sensor has been tripped. Refill the hopper or let the machine to process kernels left.

**Change bag with popcorn** — Bag sensor is tripped. Replace the full cart. Failing to do so will lead to sound alarm activation and machine will automatically go in pause mode shortly.

**Oil and salt will start automatically** — While Butterfly program in operation, this message will appear once corn kernels started to be supplied in the chamber. This is a reminder that oil and salt supply will start after certain time. See 'Oil turn on delay' setting.

**Chamber is clogged with popcorn** — Machine chamber is equipped with chamber clogging sensor that watches what is happening in the chamber. Based on the sensor's output, machine can increase turbine spinning rate automatically in order to blow out excessive stuff out of the chamber. If it is not sufficient, then sensor trips and machine switches into cooling mode, and said message can be seen on the screen.

Chamber clogging sensor trips not only in case of actual clogging, but also in case if too small amount of corn was put in the hopper or corn sensors have been blinded (for purpose or incidentally). To continue operation, related indicator should be released. See 'OVERLOAD' indicator in 'General settings screen' section.

**Automatic machine disconnection** — Machine has been forcedly switched into cooling mode. Take a look inside through the observation port in the door to make sure that the chamber is really clogged.

Also this message can be seen upon turning the machine on. To continue operation, tripped indicators must be released, see 'General settings screen' section.

**Motor turbine failure** — If the turbine speed is below 40 Hz for more than 30 sec in the beginning of heating stage the said message will appear. Call for a technician.

**Temperature sensor failure** — The temperature reading from the temperature sensor is more than 350°C. Call for a technician.

### 4.3 Chamber clogging

 <b>DANGER</b>	
	<ul style="list-style-type: none"><li>• NEVER use water in case of smoke formation.</li></ul>

 <b>WARNING</b>	
	<ul style="list-style-type: none"><li>• DO NOT open in case of smoke formation.</li><li>• DO NOT use fire extinguishers. Machine is made of stainless steel, as long as chamber is closed, popcorn won't get fire.</li></ul>

The chamber may be clogged due to the following reasons:

- Low quality corn. Un-popped kernels are accumulating in the chamber and cannot be evacuated, which causes weakened airflow, and eventually chamber clogging and smoke formation.
- Power supply issues (voltage drop, power cut-off) or actuating Emergency stop switch that causes turbine stop, which leads to steep temperature rise inside the chamber, and eventually chamber clogging and smoke formation.

#### **IN CASE OF CHAMBER CLOGGED OR SMOKE FORMATION, DO THE FOLLOWING:**

1. UNPLUG the machine.
2. WAIT until machine COOLS DOWN.
3. Open the chamber and thoroughly clean inside.
4. If corn supply tube is clogged with corn kernels and popped popcorn, use the cleaning brush from the delivery set to remove popcorn stuck in the tube and to clean the tube.

#### **4.4 Notes on using oil and salt**

Most kinds of liquid oil without any added powder may be used.

Oil pumping rate depends on oil thickness; it is essential to avoid oil temperature fluctuations to keep pumping rate the same.

To be sure that oil is kept at the same temperature following conditions must be met:

1. OIL WARM switch must be at ON position all the time, even at night, to maintain stable temperature of oil inside the cabinet.
2. Oil cabinet doors must be kept closed all the time.
3. The cabinet have enough space for two 22 kg oil containers. It is recommended to keep two containers, and to replace empty one in time.

Oil cabinet heaters are not intending for melting oil, and can work as intended only when proper ambient temperature is maintained in the production room. If machine is in a cold room, oil temperature will be lowered, even with oil warm heaters on, and oil might get solidified.

The machine is intended for using with special salt only. Using common salt or powders of other kind (e.g. cheese or sugar) may lead to salt applicator clogging and equipment failure.

While colored oil is used, freshly made popcorn with oil and salt may have patchy look and oily feeling. While being processed further, oil will be spread across popcorn in even manner, and soaked into popcorn.

#### **4.5 Abnormal operation**

In case of any signs of abnormal operation of the machine, such as distinctive smell, smoke formation, loud side noises, and so on, turn the machine off, de-energize the wall receptacle from the switchboard, and call for a technician.

## 5 HMI interface

The HMI interface consists a range of screens, that provide ability of controlling and monitoring of machine operation, changing parameters of operation and settings of the machine, and also testing of the machine.

### 5.1 Start screen

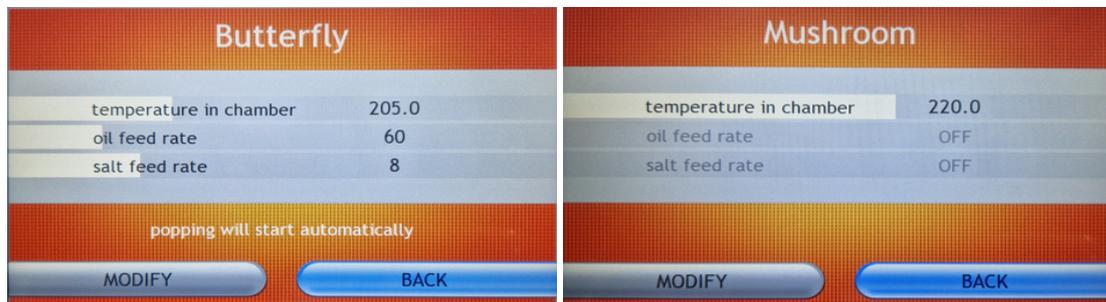
Once machine turned on, start screen appears:



There are two program buttons, BUTTERFLY and MUSHROOM, which allow to run the machine for processing corn from either of two corn bins.

### 5.2 Program settings screen

Once program button is pressed, a screen with program settings appears:



Here one can change temperature for certain program, and also oil feed rate and salt feed rate for Butterfly program only. When operated in Mushroom program, no oil and salt are used.

To change the parameters, press MODIFY button, then enter 2325 password (can be changed, see General settings screen section). ATTENTION! If no button pressed, the machine will proceed to heating stage automatically in 15 seconds. After this moment you won't be able to change parameters until machine switches to popping mode.

During operation, the machine maintains the chamber temperature at set value. Due to different features of used corn and chosen settings, and also nature of complex processes happening in the chamber, slight temperature fluctuation is allowed ( $\pm 5$  °C).

Popping temperature affects the way how popcorn pops; its shape and size. Too high values lead to smaller popcorn. Too low values lead to reduced productivity, improperly popped kernels, and chamber clogging.

It is recommended to choose popping temperature set value for Butterfly from 200...215 °C range; and for Mushroom from 210...225 °C range.

Due to thermal lag, it takes few minutes to see the result once the temperature has been changed.

### 5.3 Operation screen

During popping mode, the following screen appears:



Left upper corner reads the current temperature in the chamber.

PAUSE button used to switch the machine to pause mode. Pause mode is intended to put production process on hold for some time, or to change the program. DO NOT use pause mode to change full popcorn cart, since this will affect quality of the end product. It is recommended to have long sessions for each program, without interruption of corn feeding.

Sprocket icon button in the right upper corner is used to access program settings, general settings, or temperature graph screen. To enter those screens, press and hold the button for 1 second, then press MODIFY button, and after this type '2325' or '6666' or '3333' password, respectively, and finally press ENTER.

TURN OFF button used to switch the machine to cooling mode.

### 5.4 Temp graph screen

Temperature graph screen represents the temperature in the chamber in real time, which is useful for diagnostic purposes:



Left upper corner reads the current temperature in the chamber.

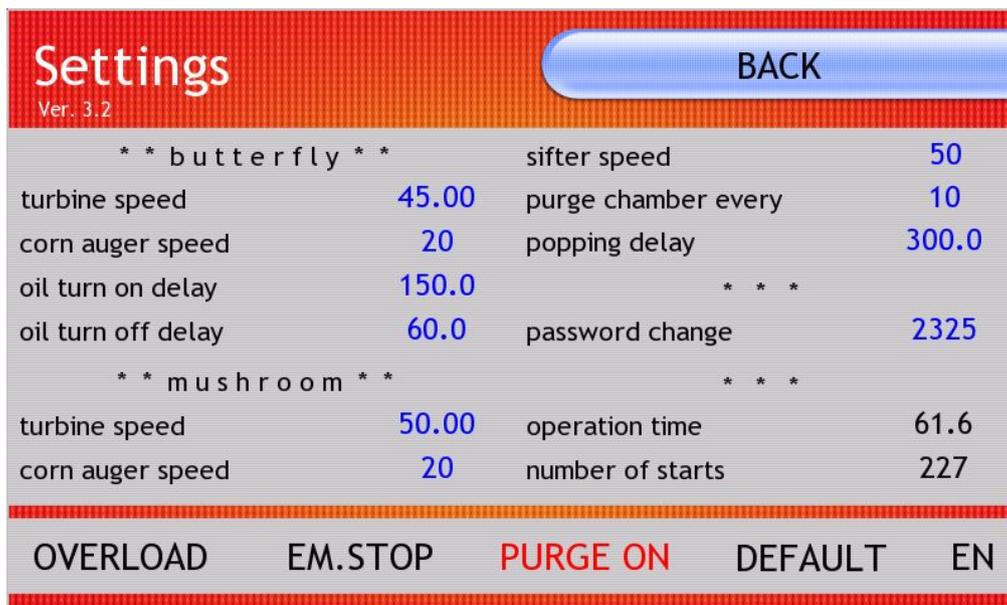
Middle white line represents the set value. Two other white lines, above and below, represent the value 10 degrees more and less, respectively. The screen fit 30 minutes of temperature log.

In the lower part of the screen are PID parameters.

To exit the screen, press BACK.

## 5.5 General settings screen

To enter general settings screen press SETTINGS on the start screen, type 6666 on the screen keypad, and then press ENTER, the settings screen appears:



**Turbine speed** — defines the speed of turbine rotation. With higher value, airflow in the chamber is stronger. Too high value causes higher rate of scrap. Too low value increases risk of chamber clogging.

**Corn auger speed** — defines the speed of corn auger rotation. Higher value causes more corn pushed in the chamber. Choose the value depending on corn quality. Too high value can cause chamber clogging.

**Oil turn on delay** — defines the delay in seconds for starting oil pump and salt supply system, counted from the moment of popping mode start.

**Oil turn off delay** — defines the delay in seconds for stopping oil pump and salt supply system, counted from the moment when machine is switched to cooling mode.

**Sifter speed** — defines rotation speed of the sifter.

**Purge chamber every** — when the indicator PURGE is toggled in 'PURGE ON', the machine automatically initiates purge mode (turbine increase rotation speed for short time in order to blow out scrap from the chamber).

**Popping delay** — the time machine waits before starting popping mode, in order to make sure that the chamber is heated evenly.

**Password change** — to change the password that is required for program settings.

**Operation time** — total time of machine operation, in hours.

**Number of starts** — total count of start up for the turbine.

**OVERLOAD (OVER.LOCK)** — red value represents tripped chamber clogging protection. Needs to be released before continue operation. To release, press and hold for 1 second, until it beeps and turns to black.

**EM.STOP (EM.LOCK)** — indicator is tripped (becomes red) whenever the machine is turned off while it is hot (in case of using emergency switch, or sudden power loss in the service grid). Needs to be released before continue operation. To release, press and hold for 1 second, until it beeps and turns to black.

**PURGE (PURGE ON)** — indicator for automatic purge feature. When black, it is not activated. When red, it is activated. See also 'Purge chamber every' setting.

**DEFAULT** — reset all settings to default.

**EN** — change the interface language.

The general setting screen can be also accessed while machine in popping mode. To do so, press and hold the sprocket icon button for 1 second, then press MODIFY button, type '6666' password, and then press ENTER. After this the general settings screen appears, but OVERLOAD, EM.LOCK, and PURGE indicators won't be shown; instead there will be message 'VFD MOTOR RUN', which means the turbine in operation.

## 5.6 Testing screen

To enter Testing Screen press SETTINGS on the start screen, type 3333 on the screen keypad, and then press ENTER, the testing screen appears:



In this screen one can check operation of different parts of the machine, and also see the status of its sensors and so on.

**VFD MOTOR RS485** — Turbine on/off.

**Y0.SA SIFTER** — Sifter on/off.

**Y1.SA OIL PUMP** — Oil pump on/off.

**Y2 CORN FEED.L** — Left corn feeder (Butterfly) on/off.

**Y3 CORN FEED.R** — Right corn feeder (Mushroom) on/off.

**Y3.SA SALT FEED** — Salt auger on/off.

**Y4.SN SALT FAN** — Salt blower on/off.

**DTC1000\_RUN** — Heaters on/off.

NOTE 1: Heaters can be turned on only when turbine (VFD MOTOR RS485) is on.

NOTE 2: During testing mode heaters work at 100%, without PID regulation, so one should control the temperature in the chamber to avoid overheating.

**PROBE TYPE K** — Temperature sensor type change (type K or Pt100).

**Y5.SN BUZZER** — Buzzer on/off.

**VFD** — Adjusts speed of turbine rotation. Effective only while in this screen, it does not affect the turbine speed set in general settings screen.

**OIL** — Adjusts oil pumping rate. Effective only while in this screen, it does not affect the oil pump speed set in Butterfly program settings screen.

**SALT** — Adjusts salt supply rate. Effective only while in this screen, it does not affect the salt supply rate set in Butterfly program settings screen.

**T.** — Current temperature in the chamber.

Press BACK to exit the screen.

**X0 Sensor chamber** — Status of the fiber amplifier (turns red while tripped).

**X1 Button SIFTER** — Status of the SIFTER push button (turns red while pressed).

**X2 Button WARM** — Status of the OIL WARM push button (turns red while pressed).

**X3 Sensor Corn Left** — Status of level sensor in Butterfly corn bin (turns red while tripped).

**X4 Sensor Corn Right** — Status of level sensor in Mushroom corn bin (turns red while tripped).

**X5 Sensor Bag** — Status of level sensor for popcorn cart (turns red while tripped).

**X6 Heater Ctrl**— Status of AL output of the thermal cut-out (turns red if on).

## 6 Cleaning

### **DANGER**



- ALWAYS unplug before cleaning.
- DO NOT use excessive water or water jet for machine cleaning. DO NOT spill water on electric panels or parts. Using excessive water during cleaning can cause short circuit and electric shock.
- DO NOT immerse machine and/or supply cord into water.
- DO NOT keep supply cord on the floor.

### **WARNING**



- Internal surfaces are hot. Touching hot surfaces might cause burn. ALWAYS wait until cooled down before cleaning.

### **CAUTION**



- DO NOT use high alkaline cleaners, sharp items, or abrasives while cleaning.

The purpose of maintenance and cleaning is to keep machine in good condition during all the lifetime and to meet safety requirements.

### 6.1 Daily cleaning

1. Unplug the machine.
2. Inspect supply cord, cable plug, and wall receptacle for any damages. In case of found damages DO NOT use the machine until damaged parts replaced.
3. Clean outer surfaces of the machine with a soft and clean cloth dampened with mild detergent. Wipe with a clean cloth dampened with water to remove detergent residues. Let it dry.
4. Remove un-popped kernels and debris from perforated bowl.
5. Remove dust from internal surfaces of the chamber with the means of soft dry clean cloth. Avoid hard impact to the optical sensor.
6. Clean the mesh screen with a suitable brush or vacuum cleaner.
7. Take out the salt supply tube. Wash salt supply tube with water. Let it dry completely, before putting back. Failing to do so might cause salt clogging. When installing the tube back, make sure that the dot mark on the tube is directed straight to you (given that you stand in front of controls), thus proper angle is provided.
8. Take out crumb tray and empty it; wash the tray to remove grease and dust, let it dry.

## 6.2 Weekly cleaning

1. Empty the corn bins and salt bin.
2. Remove wing-screws that fix the corn bins; remove the bins by pulling them out.
3. Wipe internal surfaces of corn bins with a soft clean cloth dampened with mild soap; then remove soap residues with a cloth dampened with water. Let it dry.
4. Wipe corn augers with dampened cloth.
5. Take out the sifter (Fig. 3 pos. 1) from rollers (Fig. 3 pos. 2 and 7). To do this, first remove the salt supply tube, then lift the sifter a bit, and take this out.
6. Remove internal blades of the sifter, by unscrewing wing screws. Wash sifter and blades with mild soap in order to remove grease and dust. Rinse with water, let it dry. Mount the blades back to the sifter.
7. Idle and drive rollers (Fig. 3 pos. 2 and 7) have two wheels each. Clean the wheel surface with a stiff brush or Scotch-Brite sponge, to remove grease and dust formation. Failing to do so might lead to sifter slipping, and eventually to chamber clogging.
8. Clean internal surfaces of sifter cabinet with a cloth dampened with mild soap. Remove soap residues with a cloth dampened with water. Let it dry.
9. Put the sifter back on the rollers. Make sure the rims of the sifter fit the wheels. Make a full round by driving the sifter with a hand.
10. Put the bins back on their places, fix with wing-screws.

## 7 Technical service

 **DANGER**



- ALWAYS unplug while servicing.
- Technical maintenance and repair **MUST** be conducted by a qualified technician only.
- A warning tag (DO NOT TURN ON! WORK IN PROGRESS!) must be placed at the switchboard during servicing.

 **WARNING**



- ALWAYS use safety goggles while servicing.

### 7.1 Technical maintenance

To provide good and safe operation of the machine, it is a must to conduct technical maintenance on regular basis, and operating repair, as needed.

**Technical maintenance** — scope of work, which goal is to maintain the machine in operable condition during intended use.

**Operating repair** — scope of work, which goal is to recover the machine or its parts in case of malfunction, and renewal of its resource.

- Technical maintenance stage 1 must be conducted every 360 hours of machine's operation.
- Technical maintenance stage 2 must be conducted every 1000 hours of machine's operation.
- Operating repair must be performed as needed.

It is a must to conduct technical maintenance while performing operating repair.

#### 7.1.1 Technical maintenance Stage 1 schedule

1. Ask the operators who work with the machine for any issues related to the machine and its operation.
2. Ensure that the machine is installed in accordance with the installation instructions (see section 3).
3. Visually inspect the machine to detect any faults or broken parts. Make photo as necessary.
4. Inspect supply cord, cable plug, and wall receptacle. Pay attention to mechanical damages, damaged insulation, and colour changes. Replace damaged components.

5. Check the cable gland for supply cord. Cord must be tightly secured by the gland. Tighten loosen gland.
6. Check the resistance between the grounding pin in the plug and accessible conductive parts. The result must not exceed 0,2 Ohm.
7. Check connection and continuity of the equipotential bonding wire.
8. Make a record about conducted maintenance in the corresponding section of the machine's factory certificate.

### 7.1.2 Technical maintenance Stage 2 schedule

1. Unplug the machine. Open the electric panel. Remove dust and debris from inside.
2. Inspect internal wiring and components; pay attention to mechanical damages, insulation colour changing. Replace damaged wiring; restore markings on the wiring.
3. Tighten contact joints and terminals of main current conducting parts, terminal block and connectors. Face up pitted contacts as necessary.
4. Open the chamber door, then remove cover, and heat insulation mat to get access to the heating elements terminals and busbars, see Fig. 5. Inspect busbars (2), wires (4), terminal studs (5) of the heaters, and also wiring for temp sensor BT1 (3).
5. Check conditions of the door seal (1). If worn out, replace the seal.



Figure 5

6. Check the heaters EK1-EK4. There should be no open or close circuit, nor ground fault. While at room temperature, resistance of each element should be around 21 Ohm. If

heating element terminals, busbars or wires corroded or burnt, replace them. While replacing, use electro-conductive anti-seize paste.

7. Open terminal box of M1 motor (turbine). Inspect terminals of the M1 motor as well as respective wiring. Tighten terminals and face up pitted contacts as necessary. Check the motor. The rotor should spin freely. Make sure that there is no open or short circuit, nor ground fault in its windings. The resistance of each winding must be about the same.
8. Take out the sifter. Inspect condition of the wheels on idle and drive rollers. If wheels are worn out, replace them. Check mechanical joints of both rollers; tighten as necessary.
9. Check the swivel casters condition; check the operation of casters' brakes.
10. Make a record about conducted work in the corresponding section of the machine's factory certificate.

## 7.2 Lamp replacing

1. Unplug the machine. Wait until cools down.
2. Open the chamber. Lamp is located on a side wall of the chamber, see Fig. 6.
3. Remove two screws (1) that holds protective cover (4); then take the cover off. If it is stuck, carefully insert flat screwdriver under the metal frame of the cover and turn it gently to detach the cover.
4. The lamp (3) is held by two spring loaded lamp sockets (2). Take the lamp firmly and press towards one of the socket, then release the opposite end of the lamp from the socket, and finally release the second end and take the lamp out.

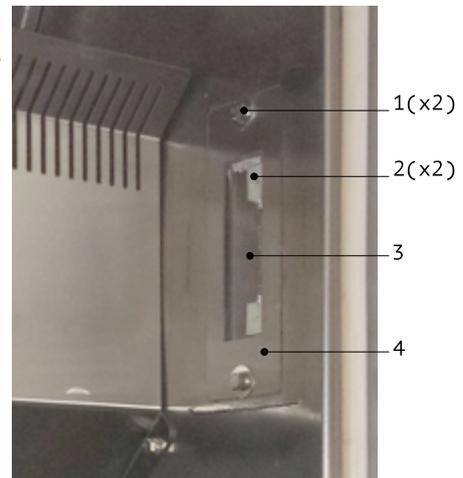


Figure 6

5. **ALWYAS WEAR GLOVES WHILE REPLACING THE LAMP!** Skin grease will significantly reduce the lifetime of the lamp. Use a soft clean cloth or gloves to take and install the new lamp.
6. Insert the lamp in the sockets in the same way.
7. Close the protective cover and fix with screws. Use anti-seize paste of NSF H1 type (incidental food contact) on the screws.
8. Close the chamber.

### 7.3 Electric panels layout

Electric panels component layout is shown on Fig. 7. The component designations corresponds to the same on the wiring diagram.

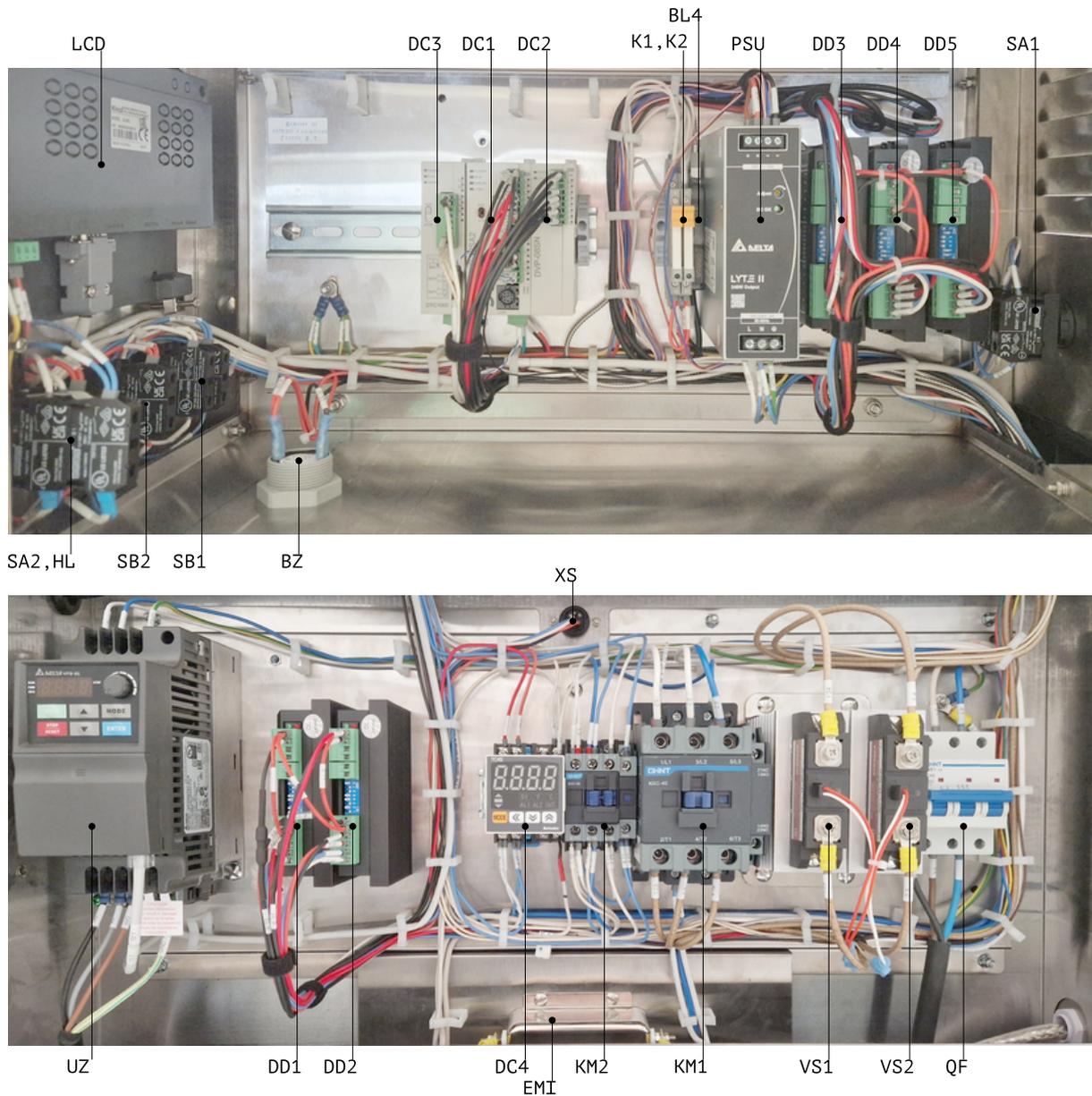


Figure 7

## 7.4 VFD unit

### DANGER



- High voltage remains in capacitors in the output circuit of the VFD unit.
- WAIT AT LEAST 10 MINUTES after VFD unit is de-energized, and then confirm that the capacitors have fully discharged by measuring the voltage between braking module terminals  $\oplus$  and  $\ominus$ ; it should be less than 25 Vdc.

The VFD unit (hereinafter — unit) drives the turbine motor.

The unit is supplied from input terminals (1), see Fig. 8. Control panel (2) allows to change parameters of the unit. Motor is connected to output terminals (4). Braking module terminals (3) might be used to control residual voltage in the output circuit of the unit.

To see and change parameters of the unit, follow these steps:

1. To change or view a parameter value, press  , the display reads 00
2. Press  or  to choose the first two digits of the parameter, e. g. 02
3. Press  again, display reads 02.00
4. Press  or  to choose the second two digits of the parameter, e. g. 02.11
5. Press  again to see the current value of the parameter. If needed, change the value with  or .
6. Press  to confirm and save the new value, the display reads 'End'.
7. Press  to return back to the previous level of selection or to the main mode.



Figure 8

Unit settings chart is given in Table 1.

**NOTE 1:** Some settings can be changed only when the unit is stopped.

**NOTE 2:** Once parameter 00.02 set to 9, VFD display reads 'End', and then gets back to the main indication mode. After this, continue setup process from parameter 00.03.

**NOTE 3:** Parameters not listed in the chart should not be modified.

Table 1: VFD unit UZ settings

Parameter	Value	Description
00.02	9	Parameter reset
01.00	70.00	Maximum output frequency
01.16	4	Auto acceleration/deceleration
02.00	3	Source of first master frequency command
02.01	4	Source of first operation command
02.07	1	Up/Down Mode
02.11	40.0	Keypad frequency command
09.00	5	Communication address
09.04	1	Communication protocol

Error messages might appear on unit display, see possible errors and suggested actions in Table 2.

Table 2: VFD errors

Error	Meaning	Remedy
CF3.3	DC bus fault	Replace the unit. Disconnect motor from the VFD unit. ATTENTION! See safety precautions in VFD settings section. Check the motor windings to see if there is no short or open circuit, as well as ground fault. Check (U), (V), (W) terminals of the VFD unit, there should be no ground fault.
GFF	Ground fault	Replace fault unit. Disconnect motor from the VFD unit. ATTENTION! See safety precautions in VFD settings section. Check the motor windings to see if there is no short or open circuit, as well as ground fault. Make sure there is no excessive load on the motor's shaft. Check (U), (V), (W) terminals of the VFD unit, there should be no ground fault. Replace fault unit.
oc	Over current	Replace fault unit.
oL	Overload	Make sure there is no excessive mechanical load on the motor shaft.

## 7.5 Fiber amplifier

The purpose of fiber amplifier BL4 is to watch the processes happening in the chamber. The amplifier uses heat-resistant fiber that conduct light from the amplifier to the chamber. Head of the fiber is located adjacent to the temperature sensor inside the chamber. Principle of operation is the following: light is emitted from the fiber head, whenever there is an obstacle (a kernel of corn) crosses the light beam closer than certain distance (sensing distance), the amplifier changes its output (sending it to the main PLC).

The sensing distance must be set for approx. half of the distance between two sidewalls of the chamber. Setup procedure is as following:

1. Locate fiber amplifier in electric panel, see Fig. 9.
2. Ensure the fiber connector (3) is properly connected to the amplifier.
3. Set the timer switch (7) to OFF.
4. Set the mode selector (8) to L.
5. Put a folded sheet of white paper in the chamber, so the light beam from the fiber head (1) reflected by the paper screen and then returns back to the amplifier.
6. Check to see if the operation indicator is on. If yes, then rotate the adjustment screw counter-clockwise, until operation indicator turns off. Otherwise proceed to the next step.
7. Slowly rotate the adjustment screw clockwise until operation indicator turns on, and then stop rotation immediately. Incident level indicators represent amount of the light reflected and received by the amplifier.
8. Remove paper screen from the chamber.

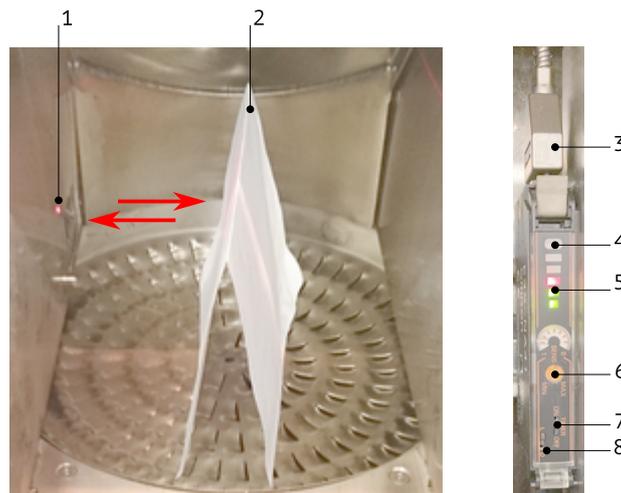


Figure 9

## 7.6 Thermal cut-out

Thermal cut-out DC4 (hereinafter — unit) connected to the sensor BT1 located in the heating elements area. Output of the limiter drives the contactor KM1 that feeds the heaters. If the temperature in the heaters area reaches 350 °C (SV+AL1), the PLC is shutting down the heating. If temperature keeps rising, then upon reaching 370 °C, the relay output of the unit opens the contactor, thus de-energizing the heaters.



Once machine turned on, the unit is in run mode; display reads temperature on heating elements (not in the chamber).

There are two setting groups — Group 1 and Group 2. To enter Group 2, press and hold **MODE** for 4 seconds; release once display reads 'PAR2'. To enter Group 1, press and hold **MODE** for 2 seconds; release once display reads 'PAR1'. Press **MODE** to list parameters. Press **←**, to see current value of a parameter. Press **↓** **↑** to change the value. Press **MODE** to move to the next parameter. When nothing pressed during 30 seconds, the unit returns back to operational mode. To return back to operational mode earlier, press and hold **MODE** few seconds.

To change set value (SV) use **↓** **↑**, while the unit in the run mode.

The unit parameter settings are given in Table 3. It is a must to change parameters in the same order as they appear in the chart.

After changing parameters In-t (sensor type), UnIt (measurement units), parameters H-Su, L-Su, AL1, AL2, AHYS are initialized and must be set again. The unit has more parameters than listed in the chart. Skip a parameter if it is not in the chart. Before changing parameters, set LoC to oFF in order to unlock parameters for changing.

Table 3: Thermal cut-out DC4 parameter settings

Group	Parameter	Value	Designation
Par2	In-t	YCA	Sensor type
Par2	L-su	0250	SV low limit
Par2	H-su	0400	SV high limit
Par2	C-nd	onoF	Control type
Par2	oUt	rLY	Control output type
Par2	AL-1	An.1_	AL1 operation mode
Par2	AHYS	0010	Alarm output hysteresis
Par1	AL1	-020	AL1 alarm temperature
Par1	HYS	0020	ON/OFF control hysteresis
SV	SV	370	Set value
Par2	LoC	LoC3	Lock setting

## 7.7 Stepper drivers

### ⚠ CAUTION



- Changing driver's settings while it is energized might damage the driver. ALWAYS turn off the machine before changing the driver settings.

Stepper drivers drive step motors that control corn and salt augers, sifter, and oil pump, see Table 4.

Driver appearance and its terminals layout are shown on Fig. 10.

Current-limiting resistors Rx (where x is number from 1 to 5) is spliced into the the wire coming to the "PUL-" terminals of the drivers (also see the wiring diagram).

Driver operation mode is defined by positions of eight dip-switches on the driver, marked as SW1...SW8. The driver factory settings see in the Wiring Diagram.

Table 4: Stepper drivers designations

Driver	Motor	Designation
DD1	M2	Sifter
DD2	M3	Oil pump
DD3	M4	Corn (butterfly)
DD4	M5	Corn (mushroom)
DD5	M6	Salt

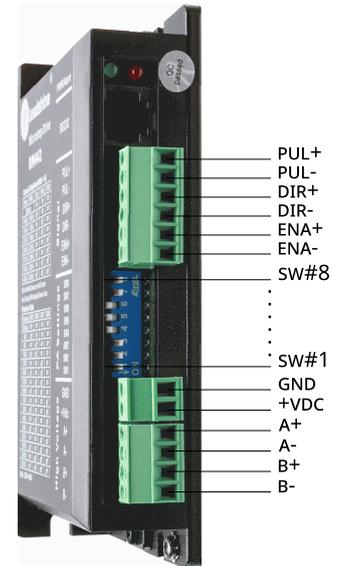


Figure 10

## 7.8 Photoelectric sensor

Photoelectric sensors BL1 (Butterfly corn bin), BL2 (Mushroom corn bin), BL3 (popcorn bag) are sensors of diffuse-reflective type. The sensor trips whenever distance (1) to corn seeds in corn bins, or popped corn in popcorn bag exceeds certain threshold, see Fig. 11.

The threshold can be adjusted with adjustment screw (3). Changing position of the sensor with fixing nuts (5) also affects the sensing distance.

Orange operation indicator (4) represents the status of the sensor output (ON/OFF).

Green stability indicator (2) represents stability of the received signal.

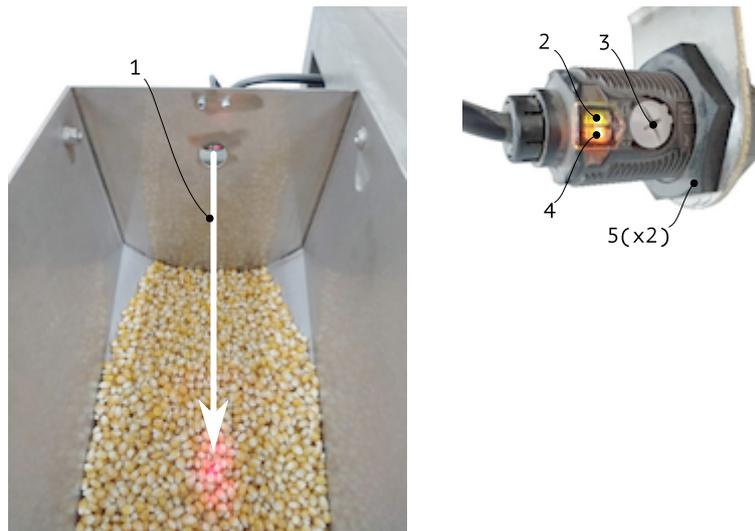


Figure 11

## 7.9 Supply cord replacing

1. Unplug the machine.
2. Open electric panel.
3. Disconnect supply cord wires from terminals.
4. Release cable gland, remove old cord.
5. Insert new cord in the cable gland; connect to the terminals.
6. Tighten cable gland; make sure the cord is secured firmly and cannot move back and forth through the gland.
7. Close electric panel.

## **7.10 Troubleshooting**

### **7.10.1 Machine does not turn on**

1. Machine is not plugged in. Plug in the machine to mains.
2. Supply cord fault. Check supply cord for continuity. Replace fault cord.
3. No power in the wall receptacle. Check the voltage in the receptacle.
4. Emergency stop switch SA is actuated. Check the position of the switch. Release if actuated.
5. Emergency stop switch SA fault. Check the switch operation. Replace fault switch or contact block.
6. Circuit breaker QF is turned off. Turn the circuit breaker on.
7. Circuit breaker QF fault. Check the circuit breaker. Replace fault circuit breaker.
8. Push button SB1 fault. Check the push button operation. While it is pressed, contacts should open or close (depending on contact block type). Replace fault push button.
9. Contactor KM2 fault. Check the contactor operation. Its core should move back and forth easily, no short or open circuit in its coil. While the core pushed inside, contacts (1), (3), (5), (13) should be closed to (2), (4), (6), (14), respectively, and should be open as the core is not pushed. Replace fault contactor.
10. Power supply unit PSU fault. Check power supply unit. While mains voltage 230 VAC applied to (L) and (N) terminals of the unit, 24 VDC must be present at output terminals (+V), (-V). Replace fault power supply unit.
11. HMI panel LCD fault. With 24 Vdc applied to terminals (24V) and (0V) the screen should lit up. If not, replace the panel.
12. Open circuit. Check continuity between: QF, EMI, KM2, SA1, SB1, PSU, DC1. Restore connection, face up pitted contacts, tighten loosen contacts.

### **7.10.2 Machine does not turn off**

1. Relay K1 fault. Check relay operation. When control voltage is applied to terminals (A1+) and (A2-), contacts (11) and (14) must be closed, contacts (11) and (12) must be open, and vice versa if no control voltage applied. Replace fault relay.

### **7.10.3 Chamber lamp does not work**

1. Lamp EL fault. Replace fault lamp.
2. Open circuit. Check continuity between: EL, KM2. Restore connection, face up pitted contacts, tighten loosen contacts.

#### **7.10.4 No heating, not enough or unstable heating**

1. Phase loss. Check if all phases present at the machine's input and the voltage is in allowed range, 230 V  $\pm$ 10% between the neutral (N) and each phase wire (L1, L2).
2. Heating element EK1-EK4 fault. Check heating elements with a tester. There should be no open or close circuit, nor ground fault. Resistance should be around 21 Ohm for each element. Replace fault components. While replacing, use electro-conductive anti-seize paste.
3. Corroded busbars. Check busbars. Replace burnt/corroded busbars. When installing new busbars, use anti-seize electric-conductive paste on wire/terminal/busbars connections.
4. Solid-state relay VS1, VS2 fault. Check relay operation. Load terminals should be closed while control voltage is applied, and should be opened otherwise. Replace fault relay. While replacing, use thermal-conductive paste applied between the relay and the heat sink.
5. Contactor KM1 fault. Check the contactor operation. Its core should move back and forth easily, no short or open circuit in its coil. While the core pushed inside, contacts (1), (3), (5), (13) should be closed to (2), (4), (6), (14), respectively, and should be open as the core is not pushed. Replace fault contactor.
6. Thermal cut-out DC4 wrong settings. Set the factory settings.
7. Thermal cut-out DC4 control output fault. Check relay output. While OUT indicator on the display is on, there should be 230 VAC on the relay output terminal. Replace fault unit.
8. Open circuit. Check continuity between: EK1-EK4, VS1, VS2, KM1, DC4. Restore connection, face up pitted contacts, tighten loosen contacts.
9. Door chamber do not close the chamber tightly. Adjust door chamber latches to provide tight closing. Replace door gasket if worn out.

#### **7.10.5 'temperature sensor failure' error**

1. Temp sensor BT2 fault. Check continuity of the sensor as well as its connection to the thermostat. Tighten the terminals, replace fault sensor.
2. Open circuit. Check continuity between: BT2, DC3. Restore connection, face up pitted contacts, tighten loosen contacts.

#### **7.10.6 False chamber clogged**

1. Fiber amplifier BL4 wrong setting. Adjust fiber amplifier as described in corresponding section of the manual.
2. Fiber head fault or misconnection. Check heat-resistant head itself, and its connection to fiber amplifier. Clean the connector. Replace damaged heat-resistant head.

### **7.10.7 Corn auger does not work**

1. Step motor M4, M5 fault. Check step motor. Its rotor should spin freely. No open or short circuit, nor ground fault in its windings. Replace fault step motor.
2. Stepper drivers DD3, DD4 wrong settings. Set the factory settings.
3. Stepper drivers DD3, DD4 fault. Check to see if there are pulse voltage on (A+), (A-), (B+), (B-) terminals of the driver during its operation. Replace fault driver.
4. Open circuit. Check continuity between: M4, M5, DD3, DD4, R4, R5, DC2. Restore connection, face up pitted contacts, tighten loosen contacts.

### **7.10.8 False reading on corn bin empty/full**

1. Photoelectric sensors BL1, BL2 wrong setting. Adjust sensing distance of the sensor, see corresponding section of the manual.
2. Photoelectric sensors BL1, BL2 fault. Check sensor operation. Replace fault sensor.
3. Open circuit. Check continuity between: BL1, BL2, PSU, DC1. Restore connection, face up pitted contacts, tighten loosen contacts.

### **7.10.9 Turbine does not spin, 'Turbine Motor Failure' error**

1. Motor M1 fault. Check the motor. Its rotor should spin freely. Make sure that there is no open or short circuit, nor ground fault in its windings. Resistance of each winding must be about the same. Replace fault motor.
2. VFD unit UZ wrong settings. Set the factory settings.
3. VFD unit UZ fault. Check VFD display for error messages. Check VFD unit operation. Replace fault VFD unit.
4. Open circuit. Check continuity between: M1, UZ, DC1, DC3. Restore connection, face up pitted contacts, tighten loosen contacts.

### **7.10.10 Sifter does not spin**

1. Step motor M2 fault. Check step motor. Its rotor should spin freely. No open or short circuit, nor ground fault in its windings. Replace fault step motor.
2. Stepper driver DD1 wrong settings. Set the factory settings.
3. Stepper driver DD1 fault. Check to see if there are pulse voltage on (A+), (A-), (B+), (B-) terminals of the driver during its operation. Also it can be checked by swapping with other driver. Replace fault driver.
4. Open circuit. Check continuity between: M2, DD1, R1, DC1. Restore connection, face up pitted contacts, tighten loosen contacts.
5. Wheels of drive roller are worn out or have greasy surface. Clean up the wheels surface. Replace worn out wheels.

### **7.10.11 Sifter does not stop once SIFTER pressed**

1. Push button SB2 fault. Check the push button operation. While it is pressed, contacts should open or close (depending on contact block type). Replace fault push button.
2. Open circuit. Check continuity between: SB2, PSU, DC1. Restore connection, face up pitted contacts, tighten loosen contacts.

### **7.10.12 Oil is not pumped**

1. Step motor M3 fault. Check step motor. Its rotor should spin freely. No open or short circuit, nor ground fault in its windings. Replace fault step motor.
2. Stepper driver DD2 wrong settings. Set the factory settings.
3. Stepper driver DD2 fault. Check to see if there are pulse voltage on (A+), (A-), (B+), (B-) terminals of the driver during its operation. Also it can be checked by swapping with other driver. Replace fault driver.
4. Open circuit. Check continuity between: M3, DD2, R2, DC1. Restore connection, face up pitted contacts, tighten loosen contacts.
5. Air lock in the oil path. Check the oil pump silicone hose; turn the pump upside down and turn it on from the testing screen.
6. Solidified oil in the oil path. Warm steel tube of the pump and immerse silicone hose into hot water to melt solidified oil. To clean U-shaped tube in the machine, use a steel wire rotated by a electric drill, or similar solution, to mechanically clean the tube inside.
7. Clogged oil nozzle. Clean out openings in the nozzle.

### **7.10.13 Salt auger does not rotate**

1. Step motor M6 fault. Check step motor. Its rotor should spin freely. No open or short circuit, nor ground fault in its windings. Replace fault step motor.
2. Stepper driver DD5 wrong settings. Set the factory settings.
3. Stepper driver DD5 fault. Check to see if there are pulse voltage on (A+), (A-), (B+), (B-) terminals of the driver during its operation. Also it can be checked by swapping with other driver. Replace fault driver.
4. Open circuit. Check continuity between: M6, DD5, R6, DC1. Restore connection, face up pitted contacts, tighten loosen contacts.

### **7.10.14 Salt blower does not work**

1. Relay K2 fault. Check relay operation. When control voltage is applied to terminals (A1+) and (A2-), contacts (11) and (14) must be closed, contacts (11) and (12) must be open, and vice versa if no control voltage applied. Replace fault relay.

2. Fan MF fault. Check fan operation, it should spin freely, no open or short circuit in its windings, as well as ground fault. Replace fault fan.
3. Open circuit. Check continuity between: MF, K2, PSU, DC2. Restore connection, face up pitted contacts, tighten loosen contacts.

#### **7.10.15 Oil cabinet is not heated**

1. Heating element EK5, EK6 fault. Check heating elements with a tester. There should be no open or close circuit, nor ground fault. Resistance should be around 81 Ohm for each element. Replace fault elements. While replacing, use electro-conductive anti-seize paste.
2. Thermostat AT1, AT2 fault. Check thermal cut-out operation. While temperature on it is lower than rated value 90 °C, it should be closed. Replace fault thermostat.
3. Switch SA2 fault. Check switch operation. Switch contacts should open and close as switch is operated, in accordance with the wiring diagram. Replace fault switch.
4. Open circuit. Check continuity between: EK5, EK6, AT1, AT2, SA2, QF. Restore connection, face up pitted contacts, tighten loosen contacts.

#### **7.10.16 No sound alarm**

1. Buzzer BZ fault. Check connection of the buzzer, and its operation. While 24 VDC of proper polarity is applied, it should give an audible signal. Replace fault buzzer.

#### **7.10.17 Circuit breaker trips**

1. Short circuit in the machine. Locate and eliminate short circuit in the machine. Replace fault component(s).