

**ДОДАТОК А**  
**Програмний код**

## Конфігураційний файл Klipper (printer.cfg)

```
# =====  
# PRINTER.CFG (Raspberry Pi)  
# Принтер Klipper  
# =====  
  
[mcu]  
serial: /tmp/klipper_host_mcu  
# Використовується мікроконтролер Raspberry Pi  
  
[printer]  
kinematics: cartesian  
max_velocity: 300  
max_accel: 3000  
max_z_velocity: 15  
max_z_accel: 100  
  
# --- Input Shaping ---  
[adxl345]  
cs_pin: rpi:None  
spi_software_sclk_pin: PB4  
spi_software_mosi_pin: PB5  
spi_software_miso_pin: PB6  
axes_map: -z,-y,-x  
  
[input_shaper]  
shaper_type_x: mzv  
shaper_freq_x: 64.6  
shaper_type_y: mzv  
shaper_freq_y: 63.8  
  
# --- Extruder з Pressure Advance ---
```

```
[extruder]
step_pin: PB0
dir_pin: !PB1
enable_pin: !PC3
heater_pin: PC8
sensor_type: EPCOS 100K B57560G104F
sensor_pin: PC1
min_temp: 0
max_temp: 250
pressure_advance: 0.04
```

```
# --- Heater Bed з PID ---
```

```
[heater_bed]
heater_pin: PC9
sensor_type: EPCOS 100K B57560G104F
sensor_pin: PC0
min_temp: 0
max_temp: 120
control: pid
pid_Kp: 69.2
pid_Ki: 1.2
pid_Kd: 994.5
```

```
# --- PID для экструдера ---
```

```
[extruder]
control: pid
pid_Kp: 22.2
pid_Ki: 1.08
pid_Kd: 114.0
```

```
# --- Макроси ---
```

```
[gcode_macro START_PRINT]
gcode:
```

```
{% set BED_TEMP = params.BED_TEMP|default(60)|float %}
```

```
{% set EXTRUDER_TEMP = params.EXTRUDER_TEMP|default(200)|float %}
```

```
M140 S{BED_TEMP}
```

```
M104 S{EXTRUDER_TEMP}
```

```
M190 S{BED_TEMP}
```

```
M109 S{EXTRUDER_TEMP}
```

```
G28
```

```
G92 E0
```

```
G1 Z2.0 F3000
```

```
G1 X10 Y20 F5000.0
```

```
G1 X100 Y20 E10 F1000.0
```

```
G92 E0
```

```
[gcode_macro END_PRINT]
```

```
gcode:
```

```
M104 S0
```

```
M140 S0
```

```
M84
```

```
G91
```

```
G1 Z10 F3000
```

```
G90
```

```
G1 X0 Y200 F5000
```

```
[gcode_macro CLEAN_NOZZLE]
```

```
gcode:
```

```
G91
```

```
G1 Z5 F300
```

```
G90
```

```
G1 X0 Y0 F6000
```

```
G1 E5 F300
```

```
G1 E-5 F300
```

**ДОДАТОК Б**  
**Демонстраційний матеріал**

